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CONTENTS

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The aim of The Bulletin is to provide municipalities with a source of information regarding the activities of the Commission; to provide a medium through which matters of common interest may be discussed, and to promote a spirit of co-operation between Hydro Municipalities.

Official Opening of the Queenston-Chippawa Power Development

Owned by the Municipalities of the Niagara District and Operated on their Behalf by the Hydro-Electric Power Commission of Ontario

THE Queenston-Chippawa Development was formally opened on December 28, 1921, in the presence of approximately two thousand representatives of the Municipalities in Ontario, who share the ownership of this, the greatest of Hydro-Electric developments.

Precisely at 1.41 P.M. Premier Drury, assisted by Sir Adam Beck's daughter, Miss Marion, put in motion the machinery which opened the gates of the turbine of the first unit put into operation. The largest hydraulic driven generator of electricity in the World was put into operation after nearly five years of continuous effort by the engineering staff of the Hydro-Electric Power Commission of Ontario.

The opening ceremony was brief. Sir Adam standing on the steps leading to the big generator spoke in part as follows:—

"I'm too filled, too full of pride, too thrilled with what is going to take

Miss Marion Beck, Premier Drury and Sir Adam Beck at the Power House Opening.

place for the people," said Sir Adam, "to make any speech. This is a historic section of the country. One hundred years ago the armies of our people demonstrated on the heights above us what the British race can do. To-day with peace prevailing, the great peace conference under way, we are demonstrating one of the greatest natural assets in the country. It will live a long time to come."

Sir Adam Beck spoke of the period of anxiety through which the executive forces of the hydro undertaking had gone, the financial responsibility placed upon the Government, and paid tribute to the men who had worked out the details of the scheme. "The engineers are Canadians. They are our own boys, educated in our own universities. There were those who said they were amateurs, but now these boys can be accorded a position of eminence. They are freed of all anxiety, freed of all responsibility. Evidence of their efficiency is here—the greatest power plant in the whole world."

Premier Drury said, as he and Miss Marion Beck began to open the gates:

"In opening this gate I do so in the hope and belief that the development will serve the people in a way never done before. The Government has not once hindered the progress in the development. Not once was the work halted despite great difficulties. I have faith and hope that in generating this power it will take care of the financial obligations incurred. In doing so I hope it will result in great service by, for and of the people."

The ceremony of putting this enormous machine into operation was most impessive, and as the speed of the machine increased a row of lights surrounding a great sign hung on the wall high overhead gradually increased in brilliancy. The sign told its own story:

"QUEENSTON-CHIPPAWA DEVELOPMENT, THE LARGEST HYDRO-ELECTRIC PLANT IN THE WORLD; ULTIMATE CAPACITY, 650,000 HORSEPOWER."

After the formal opening, the visitors were guests of the Hydro-Electric Power Commission at a luncheon given in one of the rooms of the Power Plant, following which the speeches of the day were delivered. Sir Adam Beck was Chairman, and among those on the platform with him were: Premier Drury, Hon. Manning Doherty, Minister of Agriculture, Hon. Harry Mills, Minister of Mines; Hon. Walter Rollo, Minister of Labor; George Halcrow, M.P.P., Hamilton; Joseph Thompson, M.P., Toronto; R. Cooper, M.P.P., Welland; F.A. Gaby, Hydro-Electric Chief Engineer; H. G. Acres, Chief Hydraulic Engineer; Mayor E. S. Little, London Mayor-elect McGuire, Toronto; T. L. Church, M.P.-elect, Toronto; C. G. Adams, Manager, Bank of Montreal, Toronto; Mayor H. P. Stephens, Niagara Falls; Senator John Derbyshire, Brockville; P. W. Ellis, President, Niagara Falls Park Commission; R. J. Fleming, Toronto; Paul Schoellkopf, President, Niagara Falls Power Company, Niagara Falls, N.Y., J. W. Lyon, past President, On-

tario Municipal Electric Association, Guelph, and Samuel Carter, Guelph.

Premier Drury in his address spoke of the cost of the Chippawa Development, and expressed his faith and hope that the project would take care of the financial obligations incurred. The Premier also spoke of Hydro matters in general, and also various matters in connection with the Hydro radials.

Following the Premier's address an engrossed address, together with a loving cup, was presented to Sir Adam by the Ontario Municipal Electrical Association on the occasion of the official opening of the Queenston-Chippawa Development. Mayor-elect Alfred McGuire, Toronto, read it to the Hydro Chairman before an assembly of two thousand persons.

Sir Adam Beck was greeted with cheers as he arose to speak, opening his address with the following words:

"My heart is thrilled to-day," he declared, "to think that our troubles and our financial responsibilities, our engineering responsibilities, and all our doubts are at an end." Sir Adam, as is his custom, paid the fullest meed of tribute to his Canadian Engineers, the Hydro staff, and all the workmen engaged on the project, whose loyalty and fidelity alone, he said, made success possible to the people of the Province.

Sir Adam explained that the original estimate of $10,500,000 had been for a plant of 100,000 horse-power with a maximum capacity of 180,000 horse-power. This plan was seen to be obsolete with the increasing demand for power, and the right-of-way was increased to allow for two such canals as the one which is already built, and the canal itself was enlarged to give three times the capacity of the original canal. There had been an increase of No human being could foresee it. Yet $30,000,000, due to war conditions. No one regretted this more than he. the carrying charges of this increased cost of $30,000,000 if spread over the 1,500,000,000 kilowatt hours made possible by the initial development, would add less than one-sixth of a cent to the cost of each kilowatt hour, and it is added that most of the Municipalities show surpluses from their Hydro operations sufficient to carry this extra cost on present revenues without increasing the present rates to the consumers.

Sir Adam reviewed briefly some of the difficulties which had been overcome up to the present time, and warned the municipal representatives against any effort to create a municipally controlled Commission, which would never suffice, he said, to manage the diversity of interests represented in the power and proposed radial projects. The setting up of such a municipal commission, he said, meant the ultimate ruin and smashing of Hydro development. Very emphatically also he stressed the ownership rights of the Municipalities to the great undertaking which they had created. They were the creators and owners of the system, he said, and beyond certain responsibilities were entitled to continued ownership.

The Queenston-Chippawa Power Development

The consummation of a great public undertaking, such as the Queenston Chippawa Power Development, is assuredly an event of singular importance, especially to those who will participate most directly in its benfits.

The 28th of December, 1921, will doubtless be a memorable date in the annals of the Province of Ontario, because it marks the attainment of an object long desired. After years of effort by municipalities, working through the agency of their Hydro-Electric Power Commission, there has now been made available at cost an adequate supply of electrical energy for the service of the public, and from the Queenston-Chippawa Development the municipalities of Ontario will obtain electrical power at rates unparalleled in any similar area in the world.

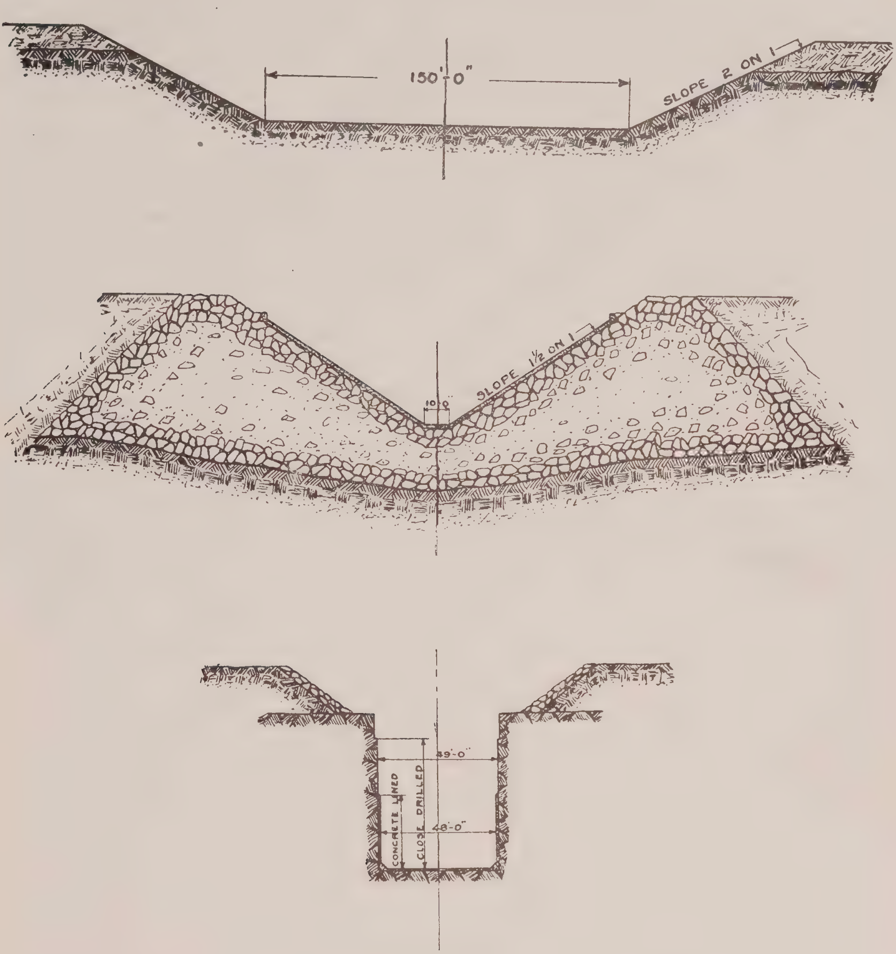
It is fitting, therefore, on this occasion of the first operation of the power equipment of the Queenston-Chippawa Development, to review some of the prominent circumstances incident to the inception and execution of the project.

Although as early as 1900, a few prominent business men in south-western Ontario commenced agitation looking towards the securing of power from Niagara Falls in order to meet the increasing demands for cheaper power on industrial centres at that time chiefly dependent for their power upon imported coal from the United States, it was not until 1903 that the Government of the Province of Ontario authorized the appointment, by the various interested municipalities, of a Commission to investigate and report upon the proposal that Niagara Power be supplied for municipal and industrial purposes. The report being duly prepared showed that the proposition promised success. Consequently, in 1906, the Provincial Government created the Hydro-Electric Power Commission of Ontario to act on behalf of the Province as Trustee for municipalities, and in due course legislation was extended empowering the Commission to proceed.

When the Hydro-Electric Power Commission began marketing power to meet the growing municipal and industrial needs of south-western Ontario, the contract it made for the delivery of 100,000 horsepower was referred to as an evidence of ill-advised procedure, but within five years the whole 100,000 horsepower had been marketed. As additional power was provided there were always those—and they were not without influence—who proclaimed that the limits of sound judgment had been exceeded. When the Commission found it desirable to purchase the Ontario Power Company's Niagara Plant and the Central Ontario Water Power System at an outlay involving about thirty-eight million dollars, the cry was raised that such expenditure was improvident and could never be justified. It was challenged, how could such large quantities of power be marketed in the districts available? In 1914, just prior to the War, it was contended that the Commission would be unable, within a reasonable period, to market its unsold power. The vital part which

this power subsequently played in the War does not need to be enlarged upon at this time. After the War, however, it was confidently asserted by parties whose opinion carried weight, that the dropping of the War power

Bird's-eye view showing intake from Niagara River above the Falls, with Welland River section in foreground leading water to Control Works at upper end of Canal, which stretches to Power House at Queenston, where water is returned to the lower Niagara River.



Canal as excavated in Solid Rock, showing Concrete Lining at bottom and Earth Slopes above.

loads would surely cripple the operations of the Commission, but it soon transpired that all these dropped loads were quickly re-absorbed and the Commission found itself again wrestling with problems arising from an acute shortage of electrical energy.

Notwithstanding the fact that opposition of this kind was being encountered, the Commission, basing its outlook upon its knowledge of underlying governing factors, felt it necessary as early as 1913 to provide for still larger power demands by preparing plans for a new development at Niagara Falls. These provisions have since taken the form of the Queenston-Chippawa development, which now commences to supply power and is designed to furnish, ultimately, 650,000

horsepower. This output the Commission expects to see absorbed as it becomes available for commercial use.

Growth of Commission's Markets

The growth of the operations of the Hydro-Electric Power Commission has been remarkable. From supplying twelve municipalities in 1910 from a single transmission system, its operations have expanded until now in 1921, from eleven distinct systems, the Commission is supplying under contract 280 municipalities and, in addition, numerous large corporations.

The following table indicates the growth in demand for hydro-electrical energy on the Commission's Systems:

GROWTH IN DEMAND FOR HYDRO-ELECTRIC ENERGY

(Hydro-Electric Power Commission of Ontario)

	NUMBER OF CUSTOMERS			TOTAL LOAD FOR OCTOBER	
	Urban Municipalities	Townships	Total Consumers	Ontario only horsepower	Ontario plus exported power horsepower
1910	10			750	
1911	26			15,214	
1912	36		34,967	31,019	
1913	51	7	65,689	45,502	
1914	82	12	96,844	76,977	
1915*	112	18	120,828	103,959	
1916	166	25	148,732	167,661	
1917†	179	34	170,916	266,214	333,399
1918	193	41	183,987	253,562	316,592
1919	208	42	216,086	262,281	328,175
1920	217	43	244,388	283,372	355,798
1921	236	44	265,000	305,247	375,010

* Central Ontario System purchased by Provincial Government and operated by the Hydro-Electric Power Commission.

† Ontario Power Company taken over by Hydro-Electric Power Commission.

Use of Electricity Rapidly Increasing

It is only a few years since electricity was a luxury within the reach of a relatively small proportion of the public, but since its cost has been reduced from about 10 or 12 cents per kilowatt hour to about 2 or 3 cents per kilowatt-hour, electricity has become a common commodity of the people. Upon the part of the general public there is a greatly increased demand for electrical energy. Electrical devices for domestic service, which even a few years ago were a novelty, have now become staple articles of every-day use. New applications for electricity in the mechanical and industrial arts are constantly being discovered.

In Ontario the use of electrical appliances is greatly promoted by the low cost of energy. In most of the Hydro Municipalities, and for less than $1.00 per month, the average family may take full advantage of the cleanliness, convenience and safety of electric lighting, while for a small additional cost, electric fans, irons, vacuum cleaners, toasters and certain classes of light cooking appliances may be utilized. Cooking by electricity, although not yet in very general use, is becoming increasingly popular.

The indirect benefits derivable from cheap power, however, are far in excess of what may be styled the immediate and more direct benefits as reflected by low bills for electric light or for electric power. For instance, the manufacture, sale and installation of electrical appliances, provide employment and profit for many.

It would be impossible here to make anything like a complete enumeration of the vast number of electrical appliances, devices, and machinery which are in every day service. Suffice it to say that electricity in its manifold applications lightens the labors of all classes of the community, contributes more than any other agency to raising the standard of living and saves money for manufacturers, business men and householders.

Power Actually Available Attracts Large Industries

It has been the experience that abundant supplies of cheap power *actually available* undoubtedly attract large basic industries, and the establishment of these, as in the case of Niagara and other large power centres, inevitably results in the establishment also of new by-pro-

Looking up a portion of the Canal, with Concrete Lining completed. Note group of men in distance.

Completed Rock Section of Canal as seen from the bottom, with Concrete Lining, and showing Niagara, St. Catharines and Toronto Railway Bridge.

duct industries—which in turn give rise to increase in population, transportation, and general prosperity such as would not have been created without there first being available large supplies of cheap electrical energy.

The HydroElectric Power Commission has been handicapped hitherto, in not having had readily available sufficiently large blocks of electrical energy—apart from those required for municipal and general industrial purposes—after the manner in which electricity has been available in certain other developing centres. This state of affairs has now been remedied by the great Queenston-Chippawa Development.

Description of the Development

Let us now consider the outstanding characteristics of the Queenston-Chippawa Development, every feature of which has been designed with the express object of producing power most efficiently from the available water at the lowest possible cost.

Before proceeding, it should be clearly understood that the Queenston-Chippawa Development, in its present condition is a much larger installation than that contemplated in 1915 when, under the exigencies of war conditions, it was proposed to construct a power development and canal with an initial capacity of only 100,000 horsepower and an ultimate capacity of 190,000 horsepower at a cost, for the initial development, of $10,500,000—a figure which, however, under the conditions which soon afterwards prevailed, owing to the War, would have become $29,000,000.

When the crisis of the war passed in July of 1918, and peace came in the following autumn, it became necessary

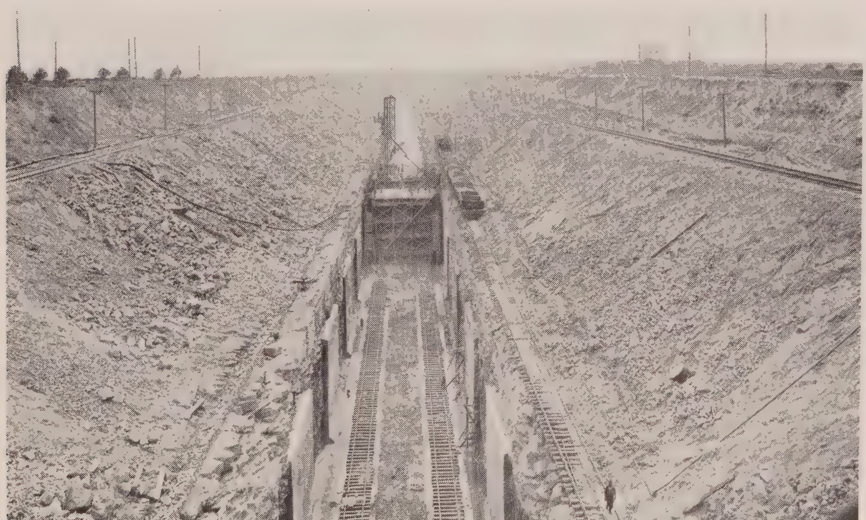
to reconsider the status of the project, and transform it as far as possible from a war measure, designed to meet an urgent and immediate need, to a commercial scheme embracing the elements both of true conservation and of ultimate maximum economy in the production of power. Space is not available to cover the steps of this transformation in detail, but it resulted in the final development as it stands to-day, with permanent works designed for the installation of plant up to an aggregate capacity of at least 550,000 horsepower, the initial development being 275,000 horsepower.

The Scheme as a Whole

The general scheme of development comprises an intake structure in the Niagara River at Chippawa; the deepening and widening of the Welland River between Chippawa and Montrose, a distance of 4½ miles; the construction of a canal 8½ miles long from Montrose to the forebay and screenhouse at a point on the cliff about a mile south of the village of Queenston; and the construction and equipment of a power house in the gorge immediately below the forebay.

Intake

The vital requirement of a power development supplying the needs of a large community is continuity of service, and one of the most frequently recurring obstacles to securing this end in Canada is the annual formation and flow of ice. This is a particularly aggravated form of trouble in the case of the Niagara River because the large fields of ice which form along the shores of the comparatively shallow Lake Erie are all discharged through the river each spring. It was only



Placing concrete lining on rock sides of Canal. Completed sections 40 feet in length in foreground with mixing plant and forms in distance.

after a long series of tests and experiments on large sized models had been made, that a design of intake was evolved which will operate satisfactorily to keep the plant absolutely free from this ice menace.

At the present time a large area of the river bed has been unwatered by the construction of coffer-dams, but the actual building of the intake structure within this area has been deferred until next season. In the meantime, water to operate the plant will enter the Welland River portion of the canal through the North Channel between Hog Island and the shore.

Canal

The cross section of the canal was fixed only after a long series of calculations had been made in order to determine the lowest cost for the maximum amount of power. In the present canal the total loss of head from Chippawa to Queenston when operating at full capacity will not exceed 12 feet.

Existing power developments on the Niagara River have only utilized that portion of the total fall of the river which occurs in the vicinity of the Falls and, for the most part, even this amount of head has been inefficiently utilized; but the basic conception of the Queenston-Chippawa Development is the utilization of the greatest possible amount of the total fall of the Niagara River between Lake Erie and Lake Ontario at the highest possible efficiency. Of this total fall of 327 feet, about 10 feet occurs in the upper Niagara River from Lake Erie to Chippawa and in the lower river from Queenston to Lake Ontario; these 10 feet it is impossible to reclaim for power purposes. Of the remaining head, about 12 feet are required to convey the water through the canal.

From the foregoing it will be seen that the average head actually available at the power house is 305 feet, which means that for every cubic foot of water that flows through the canal per second 30 horsepower will be developed. That this is a great forward step in economy is apparent from the fact that only 16 horsepower is obtained from each cubic foot of water flowing per second in the most efficient of the present three plants on the Canadian side of the river at Niagara Falls. From Montrose, on the Welland River, where the canal proper begins, the first mile was dredged through earth and is similar in section to the Welland River cut; from this point the canal, which runs in a general northerly and easterly direction, is all in rock with the exception of the built-up, rock-filled section 2,500 feet long, adjacent to the Niagara Whirlpool. The lower end of the canal opens up into a triangle-shaped forebay cut into the rock at the top of the cliff. Where the canal is in rock the sides and bottom are lined with concrete for the purpose of increasing its carrying capacity by virtue of the smooth surface thus obtained. It was estimated that the capacity of the canal will be increased 20 per cent. by means of the lining, but in view of the exceptionally fine quality of the work as actually constructed, it is now evident that an even greater increase in flow will be obtained.

Among the special features of the canal may be mentioned the massive electrically-operated Control Gate located near Montrose, for controlling the flow in the Canal; the deep excavation at Lundy's Lane crossing, where the bottom of the canal is 143 feet below the level of the ground; the various railroad and highway crossings over the canal; and the "Whirlpool Section." The last named is that part of the canal which crosses over an old gorge, the bottom of which was largely composed of quicksand. The construction of the canal across the valley was accomplished by first filling the whole gorge with rock, excavated from other parts of the canal, and then allowing this rock-fill to come to a final settlement; after this it was excavated for the canal section and faced with heavy reinforced concrete lining.

Where the canal enlarges into the forebay a triangular concrete structure has been erected which acts as a diffuser to smooth out any turbulence of the water as it enters the forebay. The dimensions and shape of this diffuser were only determined after an involved study and a series of experiments.

Screen House

The permanent screen-house substructure, to accommodate nine generating units, which extends across the lower end of the forebay, is completed. This heavy reinforced-concrete structure forms a dam at the end of the forebay and contains the moulded entrances to the penstock or pipes which convey the water down the cliff to the turbines. The sectional drop-gates foi closing off each penstock, and the screens for clearing the water of all floating trash, are located in the

Power Canal showing change in shape of the Canal as it passes from vertical faces of rock cut to sloping sides of Whirlpool section.

screen-house, and an overflow ice-chute, provided with a motor-operated gate which can be lowered beneath the surface of the water, is installed at the south end. The screen-house superstructure has been erected to accommodate six units, and is being provided with a temporary wall at the north end in order that the first five units may be operated.

Power House

The building required to house the generating and transforming equipment for the completed development will be of majestic proportions the total length will be 650 feet, while the roof will be 160 feet above the river level and the entire height from the bottom of the tail-race to the highest portion of the building is only slightly less than 200 feet. The whole structure is composed entirely of fire-proof materials—concrete, brick and steel. Inas much as the whole of the biulding is not required at present, the superstructure as constructed to-day is only one-fourth of the ultimate length.

In order to obtain sufficient area under the turbines to permit the spent water to discharge into the river, it has been necessary to excavate the rock for a depth of 25 feet below the surface of the river. To enable this work to be done "in the dry," the rock shore adjacent to the river was left undisturbed so that it formed a dam between the river and the work. It proved to be very watertight, only one small pump, operating intermittently, being required to maintain the work free from the usual water difficulties. This favorable circumstance enabled a high quality of foundation work to be done in this vital part of the plant and at the same time afforded an exceptional opportunity to make a thorough examination of the underlying rock strata, which proved to be dense and sound. At no point was any sign of settlement apparent.

Hydraulic Equipment

Each penstock after it enters the power house is provided with an automatically-operated Johnson valve, which controls the flow of water to the turbines, which are of the vertical, single-runner type, each being of 60,000 horsepower, are the largest in capacity of any hydraulic turbines ever built. Before they left the works of the manufacturers they were subjected to an hydraulic test of double the pressure under which they will operate. An hydraulic governor system is installed which will maintain constant speed on each turbine regardless of the variations in the demand for power.

Electrical Equipment

The generators, of which there are two installed at present, and of which three more are in process of manufacture, are the largest and heaviest in the world. The entire weight of the revolving parts of each generator and turbine is carried on a thrust-bearing mounted in a housing above the generator proper, the bearing being designed to sustain a weight of one million pounds. The heaviest part of a generator weighs 300 tons, and its removal requires the joint use of the two 150-ton cranes which have been installed in the power-house.

Every generator is cooled by air, which may be obtained either from outside or from inside the generator room, as desired, and it is a point of intrest to note that the weight of air required by each generator within the brief space of two and a half hours, is 690 tons—equal to the total weight of the generator itself. The speed at which each generator is designed to run is 187½ revolutions per minute.

An exciter, direct connected to the shaft of each generator, is mounted over the thrust-bearing mentioned above.

Electric power is generated at 12,000 volts, the frequency being 25 cycles. The power from each generating unit passes through 12,000-volt oil circuit-breakers and busses to a bank of 3-15,000 kilovolt-ampere transformers, by which the voltage is increased from 12,000 to 110,000. The high-voltage power then passes through the oil circuit-breakers and busses, located in the upper rear section of the building, to the roof, where the station circuits are connected to the transmission lines, which, on leaving the station, pass up the face of the cliff over the screen-house and fore-bay and radiate thence in different directions.

Power for operating the station lights, pumps, cranes, elevators, etc., is obtained from two service generators, each having a capacity of 2,500 horsepower; either of these is capable of supplying the entire demand of the station.

The control room will eventually be located above the generator room over Units Nos. 4, 5 and 6, but as this portion of the building is not yet erected, it has been necessary to provide a temporary control room in the service section for present needs.

Access to the power house will be provided by means of a high-speed elevator running from the screen house, and by a tunnel which will enter the power house near the top. A second elevator in the station will give access to all floors.

Some Striking Features

The total length of the canal is 12¾ miles. At one point the bottom of the canal is 145 feet below the original ground level. The maximum depth of cutting in earth was 80 feet and in rock, 85 feet. The width of the finished rock-cut portion of the canal is 48 feet and the depth of water is from 35 to 40 feet.

The amount of material excavated from the canal proper is over 17,000,000 cubic yards of earth and rock; the earth excavation amounts to 13,200,000 cubic yards, and the rock excavation to 4,182,000 cubic yards. Concrete to the amount of 450,000 cubic yards has been used in the construction of the canal; in June, 1921, 62,000 cubic yards of concrete were poured in 25 working days.

Preliminary work on the canal was commenced in May, 1917, active ex- March, 1918, and the canal was completed in December, 1921. At one time 8,100 men were employed on the construction work.

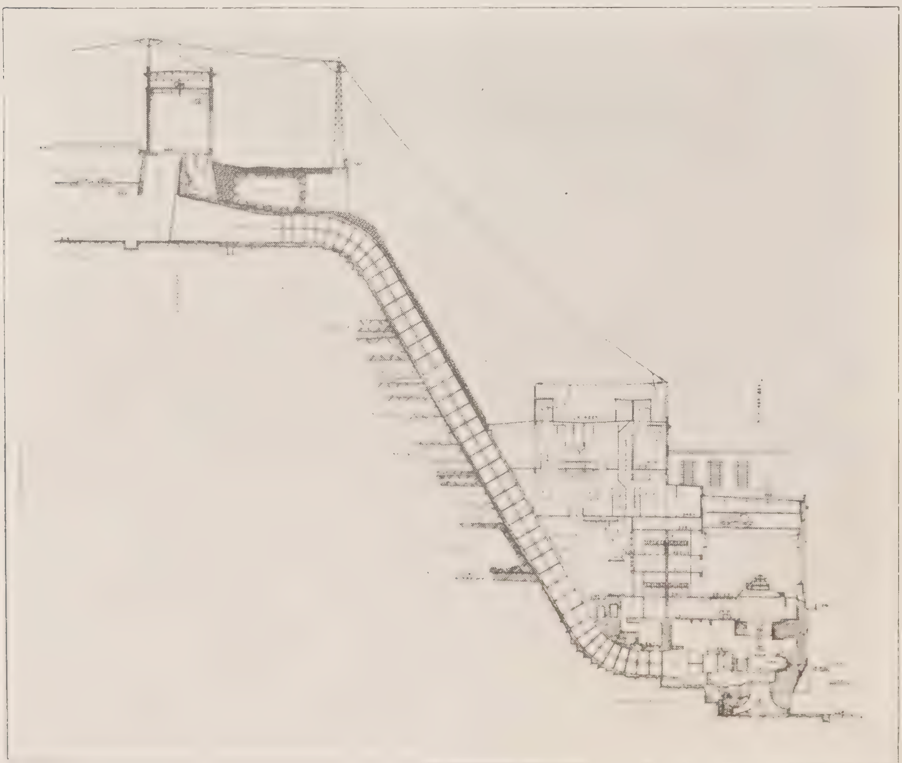
The carrying out of operations of such magnitude necessitated the creation of new engineering appliances, such as large shovels and special con-

crete forms. To handle excavated material 82 miles of standard gauge railroad track were laid. Trains were hauled by 50 locomotives the majority being electrically driven. The excavation was carried out with the aid of 14 shovels, most of which were electrically operated, and 5 of which are larger than any heretofore built; each of the large shovels was capable of loading a car of 20 cubic yards capacity, standing 60 feet above the shovel, in 1½ minutes; it could excavate a cellar for an average house in 4 minute.

During the construction of the canal, which passes beneath many of the main trunk railways on the Niagara frontier, the work of excavation was carried on and bridges were built, without any delay to traffic.

War Conditions Increase Costs

It will be recalled that the original project for the Queenston-Chippawa Development contemplated the production of 100,000 horsepower. Later on, when the necessities of the war were making increased demands upon the power supply, and when, at the same



Cross-section through Screen House and Power House, showing pipe-line down face of cliff with transmission lines above.

time, it became evident that the future demands for electrical energy for widespread use for municipal, industrial and commercial purposes would be heavy, the whole Queenston-Chippawa project was reviewed in the light of the altered conditions.

In view of all the facts, it was found best to provide for an initial development of 275,000 horsepower, a complete canal installation for a continuous capacity of 550,000 horsepower, and an ultimate capacity of 650,000 horsepower. When completed, this project will have cost about $30,000,000 more than it would have cost had it been carried out under the conditions of low cost of labor and materials prevailing in 1913 and 1914. It may be asserted, therefore, that as a result of conditions brought about by the War the Queenston-Chippawa Plant has actually cost at least $30,000,000 more than it would have cost if constructed under the prevailing market conditions of 1913-1914.

When, however, this extra cost is viewed from a proper buisness standpoint and carefully analyzed, it becomes evident that, after all, the net result to the consumer is not of serious moment, although the sum itself at first sight appears formidable.

When it is considered that the initial installation of 275,000 horsepower of the Queenston-Chippawa Development will yield in round figures 1,500,000,000 kilowatt-hours per year, it is at once apparent that even several million dollars spread over such a large number of kilowatt-hours will cause but a small increase in the price to be charged for each kilowatt-hour.

For this increased cost of $30,000,000 the annual carrying charges to cover interest and sinking fund—and even including depreciation charges—if spread over the 1,500,000,000 kilowatt-hours, would only add less than one-sixth of a cent (0.1544c.) to the cost of each kilowatt-hour.

The electric departments of practically all the Hydro municipalities have been accumulating substantial yearly surpluses from the beginning of their operation. In fact, of the municipalities comprised in the Niagara System in 1920, those which accumulated surpluses included about 90 per cent. of all the consumers. These surpluses ranged from a few dollars to about twenty dollars per horsepower per year. In these municipalities it would be possible to meet the additional cost of one-sixth of a cent per kilowatt-hour out of present revenues, without in any degree raising the existing local rates to consumers.

If the development were fully completed and the balance of the work could be executed under normal business conditions, then the increased cost of one-sixth of a cent per kilowatt-hour would immediately be halved. The extra cost, however, has here been considered in its most unfavorable aspects.

Disregarding the sinking fund charges of the Queenston-Chippawa Development only, it may be stated that when the delivery of 250,000 horsepower from the Queenston-Chippawa Plant is reached, then the average cost of Niagara power at the generating plants at Niagara will be approximately $15.00 per horsepower-

year. Due to the fact that certain low-priced power contracts were necessarily acquired in the taking over of the Ontario Power Company, the cost of power at Niagara to the municipalities will be increased over this figure by about $1.00 per horsepower-year.

It should be remembered that, under no circumstances, is this extra charge borne by anybody except the municipalities and their consumers, who have assumed the full responsibility for the Queenston-Chippawa Development.

Prospective Markets

The Hydro-Electric Power Commission believes that the 250,000 horsepower of the Queenston-Chippawa Development, which will be ready by the 31st of December, 1922, will be marketed as soon as it becomes commercially available, and it is expected that almost immediately additional units will have to be ordered for the power house.

Under anything like a return of normal business conditions there is a large electrical load awaiting the Queenston-Chippawa Plant. By way of explanation it may be stated that the Commission, in addition to the 50,000 horsepower procured under contract from the Canadian Niagara Power Company, is now obtaining under temporary agreement from outside sources in the Niagara District, 91,000 horsepower. The Hydro-Electric Power Commission is under contract to supply when demanded by municipalities and other customers, 80,000 horsepower. The increased power demands for the year 1922 over the year 1921, may conservatively be estimated at 25,000 horsepower, in view of the fact that the demand of the year 1921 over 1920 was between 60,000 and 70,000 horsepower. It is manifest, therefore, that with the purchased 91,000 horsepower, plus the customers' 80,000 horsepower, plus the 1922 estimated 25,000 horsepower there awaits under normal conditions a load of over 200,000 horsepower to be carried by the Queenston-Chippawa Development by the close of 1922.

When one contemplates the unanimous decision given by the municipalities at the polls of 1917, to assume—under the Ontario Niagara Development Act—the direct responsibilty for acquiring and developing power at Niagara, and moreover, when present circumstances are regarded in the light of the comments made in the foregoing statement, the municipalities of the Niagara District are to be highly congratulated on their enterprise and courage in initiating and carrying to completion this Queenston-Chippawa Development.

The Hydro-Electric Power Commission of Ontario, as trustee for the municipalities, believes that the future will more than justify the municipalities in the course they have taken, and the Commission further believes that no single factor will contribute more to the wholesome growth of the Province of Ontario than the economical usage of the power which will now become available as a result of this great municipal undertaking.

The Natural Foundation Laws of Service

WE ARE living in the realm of law, not luck. All life is a sequence of law. I hold an object in my hand and suddenly release it. Unless impediments prevent, it will go straight to its attraction—Mother Earth. This is perfectly natural and never varies, never changes. If I step out of my window, sixteen stories above the street, I do not break any law, but the law proceeds to break me. And we use words loosely when we say we break the law, because we don't. It would make no difference if the President of the United States stepped out of my window. The law would likewise break him on the pavement below, because man did not make this law and man cannot break it.

The laws that underlie the principle of service are just as perfect and just as real as the law of attraction, and that men do not recognize this to be true does not alter the facts. Men have been attempting in the past through organizations and individually to break some of these natural laws, and the result has always been the breaking of themselves.

The serving of the public is a subject that has been discussed before many gas and electric conventions by many individuals. Bulletins have been written treating of the effects rather than of the causes, and the reason for the "upside-downess" and the "inside-outness" of business conditions is the simple fact that institutions serving the public have had their eye upon and set their ambitions on effects rather than causes and have failed to take care of the means that naturally lead to the end.

It is perfectly natural for objects to gravitate to the earth. It is no more natural, however, than for the public to gravitate to the concern that renders service. Like attracts like, and this truth is so simple and yet so important that institutions overlook the real issue.

PUBLIC PAYS THE BILLS.

Employers have been trying to see how much they can get and how little they can give. Employees, likewise, have been trying to see how much they can get and how little they can give. The result has been a composite getting without the composite giving, and the public, being human and paying the bills, has felt this condition very keenly, which has resulted in the forming of prejudiced judgements and has torn away some of the concrete of confidence on which the public service corporations must at all times stand.

In other words, the books in the mathematics of life are out of balance. Some such spirit as this might be illustrated in the case of a fellow who appealed to the head of an institution for a job. His first question to the employer was: "How much will you pay me?" The employer replied that he would pay him all that he was

worth. The man's answer was: "Nothing doing! I am getting more than that now."

This "principle of service" does not stop with the public service corporations. It is a universal principle—one that applies to the animal world, the vegetable world the mineral world and even to the banker, and the violation of this principle has and always will mean heavy penalties. Let me illustrate in a simple way the mathematics of life as I see them, by making use of these two triangles:

Triangle No. 1 has for its right side right quantity of work, right quantity of giving. One naturally expects when he pays for service that the right quantity will be delivered, and a safe rule for all individuals connected with business in order to be sure that this side of the triangle is of the right dimension is to do a little more than is absolutely necessary. The left side of the triangle represents right quality of work or service rendered. The base of the triangle represents the mode or manner in which the work is delivered.

To apply this idea in a practical way: A bookkeeper may do all the work that is required of him and even more. He may work long hours, and faithfully, but if the quality of his work is not satisfactory, he is of no particular value to the institution. Again, he may do his work without making any errors, but if he doesn't do enough work, again his value is materially lessened and he cannot render service. Another bookkeeper may be a hard worker, his quantity of work may be right and his quality of work may be right, he makes no mistakes and is thorough in the work he does, but his manner of rendering that service, his mental attitude toward those with whom he works, his habits and so forth, his mode of conduct, may be off. In that event the two other sides of the triangle are killed. In order, therefore, for any individual engaged in human activity to render service he must have right quantity, right quality and right mode of conduct.

I know of a farmer who owns a dairy of high-grade cows, all registered, and while showing a friend of mine through his barn one day the friend observed on the stanchions of different cows letters—Q.Q.M. On some stanchions there was just one, on others there would be two Q's, and so forth. So he asked what they meant, and the farmer explained it in this manner. Pointing to a cow No. 1, he said: "Here is a cow that gives a lot of milk. Her quantity is most excellent, but her milk is bluer than a whetstone. She tests less than 3 per cent. and her quality is off. Therefore, she is going to get it in the neck." To another cow he pointed and said: "Here is a cow that gives the richest milk of all the cows in the barn, but she doesn't give enough milk to pay for the feed she is eating. Her quantity is off, and she," he added, "is going to the slaughter house." They came to a third cow, and my friend asked him about that cow, and he said: "Here is a cow that gives a large quantity of milk and gives very rich milk,

but her manner of delivery is rotten, and she is going the same way as the others." And then the dairymen took the friend to still another cow, and approaching her very gentle he said: "Here is a cow that is Q,Q,M. She gives enough milk, her milk tests a very high percentage, and her manner is fine." And he added: "I woudn't take a thousand dollars for her." That cow had a blanket on and was receiving special care from attendants and enjoying life, simply because she was rendering service.

I might go further and show how the same principle applies to the minerals, to vegetation, and so forth. But I think all will recognize that this is a universal principle that cannot safely be violated. So in the centre of this first triangle "Q Q M" we put the word "Give.".

Triangle No. 2 has for its right side the letters "SP", which means self-preservation. This is a natural feeling for all individuals, because one of the first thoughts that come to us even in childhood is to preserve and take care of ourselves. The left side of this triangle we will name "C", which stands here for contentment. The base of the triangle we will call"M", which means money.

It may be that all three of these states are essential in order to be successful. One must be contented and must preserve himself. And I have never met very many individuals who were "broke" financially and were exceptionally happy. Therefore money is essential for happiness, and it is perfectly right and proper that we should strive to accumulate money. In the centre of this triangle we will place the word "Get".

The Good Book says that the first shall be last and the last shall be first, and it is quite evident that in the attempt to serve the public many institutions and employees have been studying and practising the teachings of the Good Book, and in the mathematics of life they have put Triangle No. 2 before Triangle No. 1 This is why the books are out of balance. This is why I say that we are violating the great natural foundation law of service when we try to serve the public with the triangles in the wrong place.

Reward for Service

If at any gathering of men representing institutions engaged in commerce I should cause to be passed among the different attendants a slip of paper with this question on it,"Why are you in business?" the chances are that the majority of the replies would be, "To make money," "To make profit," and no doubt this would be a perfectly honest answer. But, as a matter of fact, these men are not in business to make money; they are in business to render service and money is simply the natural effect, that is, reward for service rendered.

Everbody knows that if he builds a little fire he gets a little heat. If he builds a bigger fire he gets a bigger heat. It is likewise true that if he renders a little service he gets a little reward and if he renders a greater service he gets a greater reward.

Action and reaction are equal, and when gas and electric companies, or other public service companies, come to a realization of this great fundamental truth, the "upside-downness" and the "inside-outness" of things are going to be adjusted. You have got to give in order to get, and the best way that I know to absolutely destroy Triangle No. 2, which is the thing that you desire—is to allow selfishness or the spirit of getting to predominate in your life and business.

In order to serve well, the individual or the collective group of individuals must first possess deeply the desire to serve. There is no weak sentimentality about this principle of service. It is a sound economic principle that does not change and cannot be violated with impunity. To the earnest man during these stressful times the only question would be "How can this be accomplished? How can I so teach myself and also my employees this principle of service that the public may first feel its effect and confidence established in their minds and that our reward may automatically come back to us?" The answer is not easy by any means, and yet this can and should be accomplished.

First Step is Salesmanship.

Millions of dollars have been poured through the gutter of inefficient training. Plans that were valuable have never been carried through because of the lack of co-operation from officials, from heads of departments or from employees. The first step that must be taken is to recognize that it is a question of salesmanship. There are three sales to be made. The first sale is from the employer to the employees in order that the employees may have complete confidence in the institution and may become boosters instead of knockers—may at all times, from the office head down to the line men, speak well of the management. The second sale is the sale by the employees back to the institution in order that the institution, represented by the executives and managers, may have this same confidence in the employees. And the third sale necessary is the composite institution, that is, from president to porter, back to the public. When these three sales are accomplished, you have what I like to call a constructive organization, a solid line-up which becomes practically impregnable. Even then some disloyalty creeps into the institution, but it is very quickly discovered and eliminated because of the general composite condition.

Disloyalty and pessimism cause a great deal of trouble, not only to the individual who is so afflicted, but to the institution in general and to the public It was true that some individuals are naturally pessimists. On the other hand, it is also true that the majority of human beings are very susceptible to development and may be taught the principle of service and will co-operate in building a real organization when they are properly instructed. It is the duty of every employer to co-operate on some fair basis with the employees, so that they may hear either some competent teacher on this subject or may have pamphlets or material that would teach

them in a simple way the mathematics of life. And it should be remembered that this great natural foundation law of service, this law of get and give, is not alone an intellectual accomplishment or a physical accomplishment. It involves the deep-seated heart stuff which is so often lacking in the organization. You can buy heads and you can buy hands, but you cannot buy hearts. But head stuff and hand stuff without heart stuff will never build a constructive organization and an enduring institution.—*Electrical World.*

Laboratory Tests on Electrically Heated Water Installations

By G. D. Floyd,

Assistant Laboratory Engineer, H. E. P. C.

WITH a view to determining the most suitable size of electric water heater for commercial use, in the homes thoughout the Province the Commission has conducted some tests on commercial heaters. The tests have also been conducted for the purpose of determining the efficiency of insulating the hot water tank and piping.

Two types of commercial heaters were used, one being the Bayonet type, and the other the Outside Circulation heater. Two sizes of tanks were proposed, of 30 gallon and 60 gallon capacity. These were to be insulated with hair felt, and an alternative insulation of corrugated paper was to be investigated. Thirty-five feet. of ½ inch galvanized iron pipe was connected to the top of the tank, so as approximate actual conditions of an installation. This was not to be insulated. A trap was to be inserted in the pipe to prevent the hot water from rising. This was to be located 18 inches from the connection to the tank. The object of this was to ascertain the increase in efficiency which might be expected from such

an arrangement. Therometers were to be inserted at the bottom, centre and top portions of the tank. Heaters of 500 watt, 660 watt and 750 watt capacity were to be used, with alternative insulations on the tank of ½″, 1″, 2″ and 3″ thickness. Four layers of corrugated paper to insulate the boiler was also requested, as an alternative insulation test.

The heaters were required to be left in service sufficient time to ascertain the temperature which each would produce when maximum point was reached, under any condition of insulation, and the time required to reach this point. It was proposed to draw off the water at the end of the 35 ft. pipe in accordance with the following schedule:—

8 A.M.	-	7	gallons
9 A.M.	-	2	"
10 A.M.	-	2	"
11 A.M.	-	3	"
12 Noon	-	2	"
1 P.M.	-	4	"
5 P.M.	-	4	"
10.30 P.M.	-	15	"

The tests were conducted in a general way, in accordance with the above directions, although changes were made in some minor details, and some additional tests have also been made. The suggestions outlined were nearly all followed.

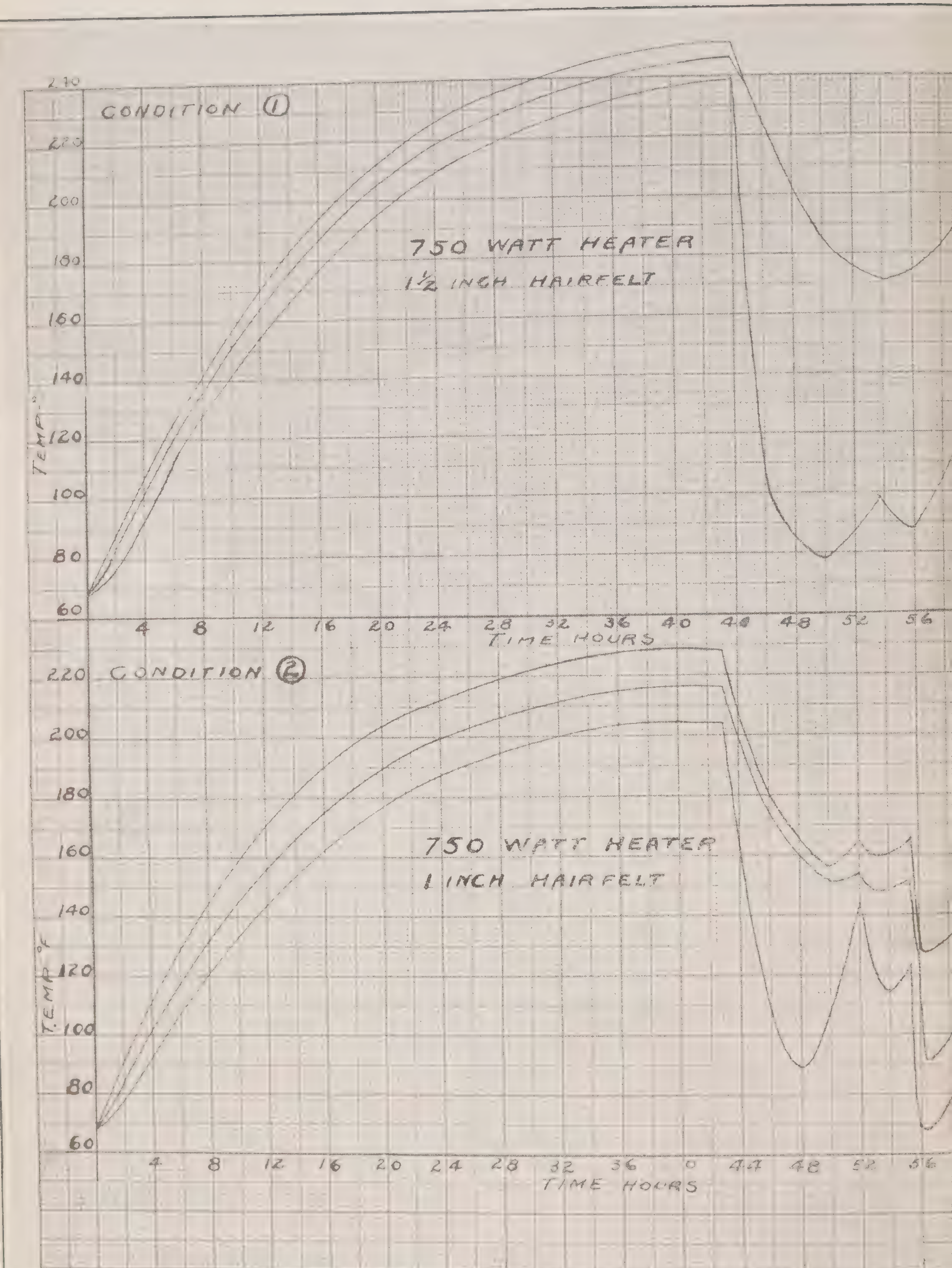
A brief outline of the tests completed to date will indicate the method used to obtain the information included in this report.

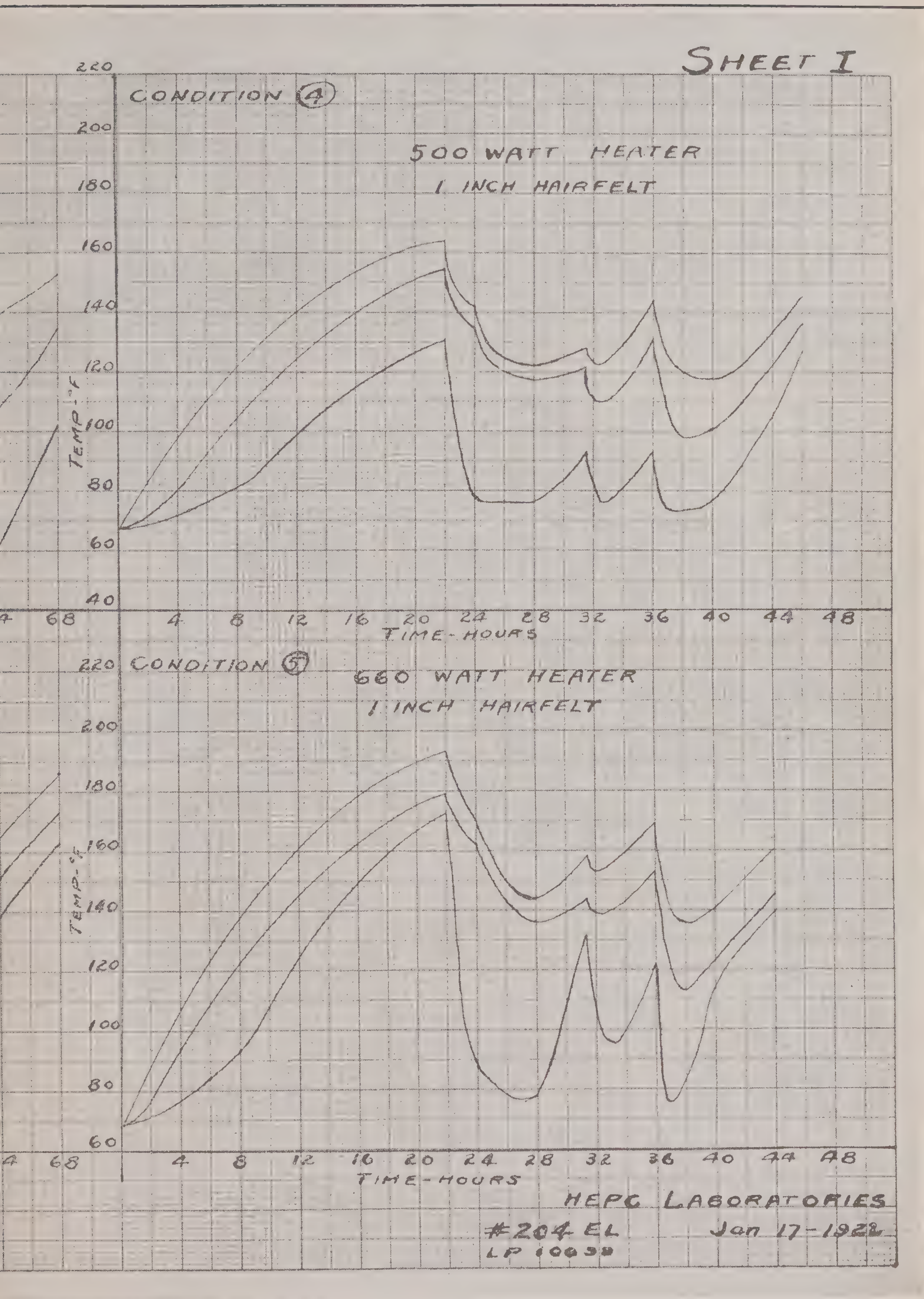
The tests to date have all been made on a 30 gallon hot water tank of standard pattern. Connected to this with suitable ¾-inch piping was a heater of the outside circulation type. Approximately 35 feet of ½-inch galvanized pipe was attached to the outlet from the tank and this piping was arranged so that free circulation of hot water could occur in it.

The first type of lagging used was hair felt, ½-inch in thickness. One layer of this was placed around the tank and also around the heater, and the pipe connecting the heater to the top of the tank. It was found after the first test that considerable loss of heat occurred from the pipe leading from the bottom of the tank to the heater, so that in each of the following tests this pipe was lagged also.

The heater was then put in circuit, and the temperature of water in the tank allowed to rise until the heat lost through the insulation equalled the heat applied, at which point the maximum temperature rise was registered. This temperature was measured by thermometers placed on the side of the tank at top, middle and bottom. Holes were not made in the tank for the thermometers as suggested, as it was found that simply placing the thermometers tightly against the metal wall of the tank would register the temperature of the water in the tank at the same point to within 2° C., which was within the accuracy possible due to variables which could not be controlled easily.

The time to attain maximum temperature was obtained, and after this temperature had been reached, water was drawn off according to the schedule outlined.


CONDITION ①
750 WATT HEATER
1½ INCH HAIRFELT
TEMP °
TIME HOURS
CONDITION ②
750 WATT HEATER
1 INCH HAIRFELT
TEMP °F
TIME HOURS


SHEET I
CONDITION 4
500 WATT HEATER
1 INCH HAIRFELT
TEMP-°F
TIME-HOURS
CONDITION 5
660 WATT HEATER
1 INCH HAIRFELT
TEMP-°F
TIME-HOURS
HEPC LABORATORIES
#204 EL
Jan 17-1922

The heater was then changed, and a similar test made with one of different watts capacity. A third test was made with a heater of a third capacity, after which a second thickness of insulation was applied and the above tests repeated.

Heaters of three capacities were used in all the tests, namely 500, 660 and 750 watts. The thickness of insulation was ½-inch, 1 inch, 1½ inch and 2 inches respectively.

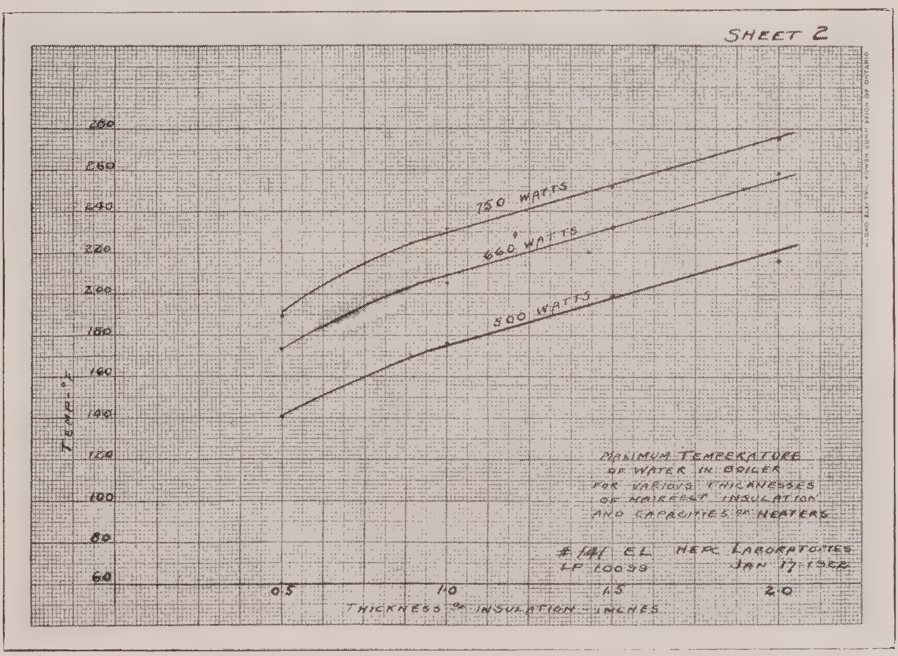
Heaters of the above capacity had been obtained in two types (Bayonet and Outside Circulation). A check test was made under similar conditions on each type. It was found that these heaters gave identical results within the limits of accuracy of the measurements made.

From the above results a series of curves have been plotted, several of which are included in this report. More complete information is available but the essential features we believe are contained herein.

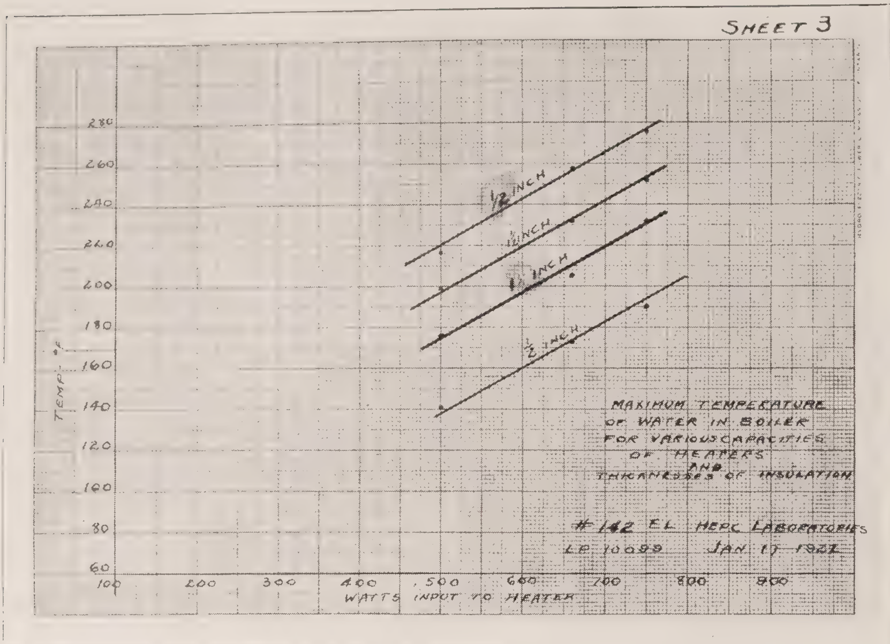
Curve Sheet 1, shows the operation of heaters of 750, 660 and 500 watts capacity with one inch of hair felt as insulation and, in addition, a curve for the 750 watt heater with 1½ inch insulation.

From these and other similar curves, sufficient data has been obtained to compile curves as follows:

Curve Sheet 2, Maximum temperatures obtained against thickness of insulation for the three capacities of heater used. This curve will give the approximate maximum temperature



Curve Sheet 2.



Curve Sheet 3.

attained with a given heater, and any thickness of insulation between ½ and 2 inches.

Curve Sheet A. Maximum temperature rise against watts input to heater, for various thicknesses of insulation. This will give the watts required for a given temperature rise, with any agreed thickness of insulation, and is simply another way of showing the curves in Sheet 2.

Curve Sheet 4. Time to reach maximum temperature against thickness of insulation.

As nearly as could be determined the time to reach maximum temperature varied directly with the thickness of insulation, but was independent of the watts input of the heater used, within the range of heaters tested.

Analysis of the performance curves indicates the following to be fairly well established:—

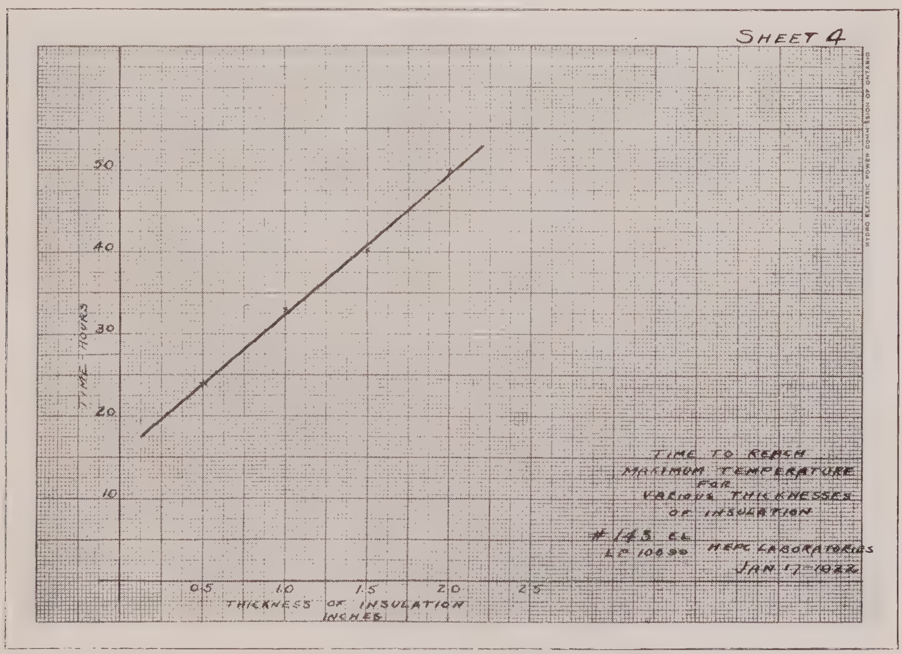
(1) The circulation around the heater is quite rapid because the difference in temperature between top and bottom of tank is relatively small as long as water is not being drawn off. This would mean that insulation of the whole body of the tank is desirable, for although the temperature at the bottom of the tank remains fairly low during the day, when water is being drawn off frequently, nevertheless, the temperature rise during the night or at any time when there is no removal of water for any length

of time would require insulation over all the tank for most efficient operation.

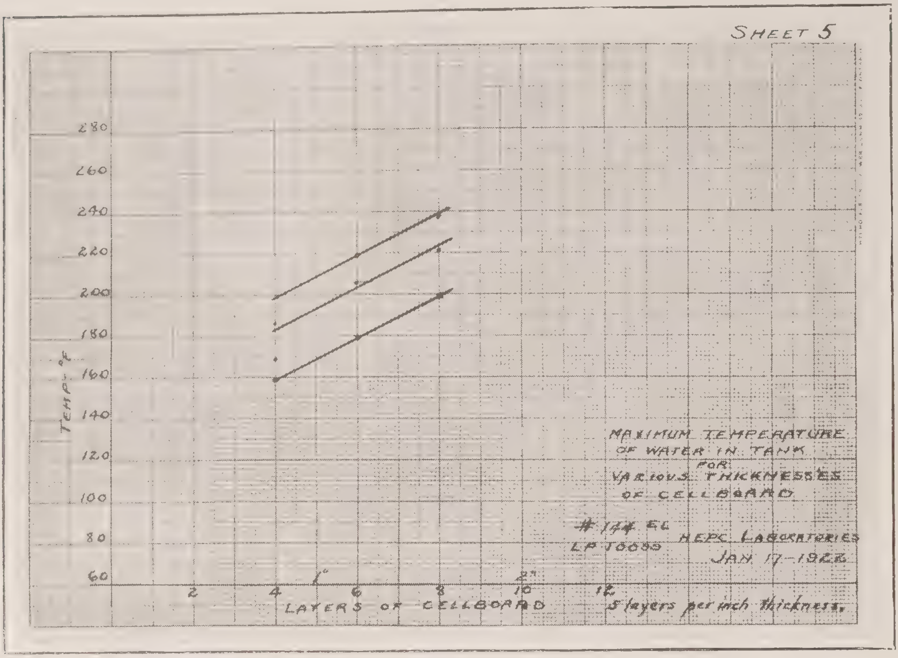
(2) The quantity of water removed is too great to permit the temperature of water to return in 9½ hours to as high a value as when water was first removed. The curves show this difference of insulation increases, for a given capacity of heater. This is no doubt due to the fact that with the thicker insulaion he boiler was toperating above the boiling point of water, when water was first drawn off. The heat of vaporization of water had to be supplied at the expense of the water remaining in the boiler, when water and steam were drawn off, hence a greater drop in temperature occurred during the time that a mixture of steam and water were drawn off. The amount of water that was drawn off could only be gauged approximately, and this would introduce an error in those cases where the water in the boiler was above the boiling point at atmospheric pressure.

(3) If the water is not to be raised above boiling point, no matter how long the tank may remain without water being drawn off, there is a limit to the size of heater that may be used, for each thickness of insulation. For example, for 1 inch of insulation, the 660 watt heater is the largest, and for 1½ inch insulation, the 500 watt heater.

(4) As stated above none of the heaters have sufficient capacity to bring the temperature back to its maximum during the period when no water



Curve Sheet 4.



Curve Sheet 5.

is drawn off, if the schedule outlined is maintained. Increasing the thickness of insulation can only be carried to a certain point, for any condition of service, if the boiling point of water is not to be exceeded. A larger tank would only be a partial solution of the difficulty. Once heated, the average temperature of water in such a tank would decrease less rapidly, but if no opportunity were given the heater to bring the temperature back to its starting point, nothing would be gained, because the input in heat units and the output in heat units removed in the water remains unchanged. There are two alternatives. (1) to alter the schedule, so that less water is drawn off, thus allowing the heater to raise the temperature of the water by the desired amount, or (2) to install an intermittent heater of larger capacity, which could be used to boost the temperature of water to the initial starting point.

Tests on Cellboard Insulation.

A few tests have been made on cellboard insulation to determine its heat insulating properties compared with hair felt. The maximum temperature rise has been determined with the three capacities of heaters, for various thicknesses of the cellboard. These values are shown on Sheet 5. There has not been sufficient time to check one or two of the points, which appear inconsistant but the curves may be used to give a direct comparison between the efficiency of cellboard and hair felt as

heat insulations. It would be expected that the thicknesses of each insulation which would give the same temperature rise would also produce similar performance curves, other things being equal.

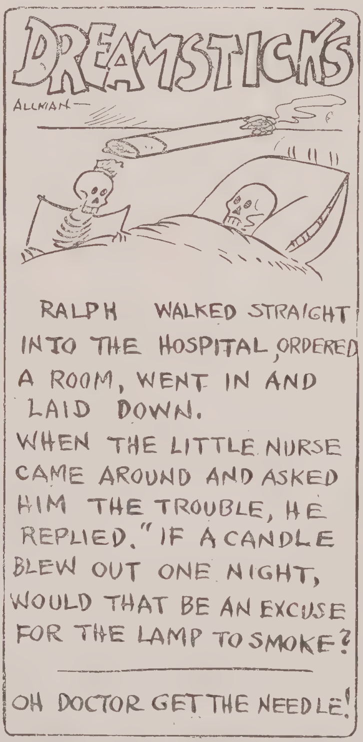
This report cannot be considered as being at all complete and a through analysis of the results obtained has not been made. The points outlined are the most obvious conclusions and the subject warrants more complete analysis, if the use of these heaters is to become general. The urgency of this report has prevented a more exhaustive study of the few results that have been obtained, For example, it was suggested that considerable loss of heat occurred due to circulation of hot water in the Outlet, if this pipe had a general upward direction This was found not to be the case, if the pipe had only a small inclination. It might be possible that if the pipe was placed vertically, considerable circulation might occur, This has not been determined as it would have meant a re-arrangement of all the piping and tank. A suggestion made by one of the manufacturers was that a combination of hairfelt and cellboard might be used profitably. This seems to be worth investigating.

This report will be supplemented at a later date, after further investigations have been made, and for the present may only be considered as a preliminary report in connection with this subject. Owing to circumstances, it has been considered necessary to have this report printed, so that interested parties may digest the contents of it, pending the receipt of further data in connection with the subject.

A novelty in the furniture line is a davenport containing a phonograph in one end and space for records in the other.

During the period of 1913-1920 Canadian bank deposits have increased from $1,109,470,920 to $2,119,727,947.

The world's production of gold dropped from $468,725,000 in 1915 to $339,400,000 in 1920.



THE BULLETIN

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CONTENTS

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FEBRUARY, 1922

The aim of The Bulletin is to provide municipalities with a source of information regarding the activities of the Commission, to provide a medium through which matters of common interest may be discussed, and to promote a spirit of co-operation between Hydro Municipalities.

Winter Convention Report, A.M.E.U.

PRESIDENT'S ADDRESS

Gentlemen, this is a meeting which I think we all look forward to. In the summer time it has usually been held at Niagara Falls—where it is to be held next summer is for the new executive to decide—but always in Toronto at this season of the year, and I am sure it is a pleasure to all of us to attend. I am glad to see so many delegates present and I hope that everybody will succeed in getting something instructive from this convention, that will be worth while to him on his return home.

It has been the endeavor of your executive during the past year to make these conventions as interesting and instructive as possible. I have heard favorable comments in regard to the convention which was held in June, and I believe that from almost every standpoint it was a success. We have endeavored to make the present convention just as interesting and instructive, and I hope you will all find it so. The papers which will be presented will I think appeal to almost every delegate, dealing as they do with matters that are at present very much to the front. I do not intend to dilate on these at all because during the session you will have the benefit of receiving all the information they contain.

Before we proceed further, gentlemen, there are one or two things which I should like to bring to your notice. Matters of great importance have arisen and have been dealt with by your executive, and I trust that the action taken will receive your approval.

The first of these matters is the merchandising of electrical appliances by the Hydro municipalities. At the suggestion of the Hydro-Electric Power Commission, through the chief engineer, Mr. F. A. Gaby, a committee was appointed by the executive of this association to co-operate with the Hydro-Electric Power Commission and consider the problems of merchandising. At the present time a certain number of our larger municipalities are merchandising electrical appliances, but the number doing so on any scale worth considering is very small. The problems confronting the smaller municipalities are very difficult to cope with, and it has been felt that closer co-operation in this respect would be a distinct advantage. Consequently this committe has been formed and already a considerable amount of work has been accomplished. We are not yet in a position to give you any details, because as a matter of fact the situation so far has been discussed only in a general way, but I hope that in the very near future every municipality will receive definite and detail information.

Another matter taken up with which you are practically all acquainted by now was that of having the seal period of inspection of electrical meters extended from five to ten years. This matter has been taken up in conjunction with the Canadian Electrical Association and memorials have been prepared endorsing the extension. I think practically every municipality received a memorial for signature and return, and these memorials will be presented to the Department of Trade and Commerce at Ottawa.

In this connection memorials were received from all over the Dominion covering more than 75 per cent. of the meters now in use in this country. These memorials should have great weight at Ottawa, and we are looking forward to having some action taken by that Department as the result of our efforts in this direction.

The third matter I can give you no definite information on as yet. Possibly many of you remember some months ago an editorial in the ELECTRICAL NEWS with reference to the over-lapping and lack of efficiency in our electrical organizations on account of each organization carrying on the same or very similar work in different sections, and therefore doing a large amount of work itself which might very well be combined. The editorial suggested that something might be done to form a central electrical organization for the Dominion.

This matter has reached the stage where our executive has been asked to appoint a committee to meet with committee from the various other electrical organizations to consider whether such a central body could be formed and on what basis. A committee has been appointed by our executive, and I may tell you that a meeting is called for February 6th, in Montreal, at which your committee and the committees from the Canadian Electrical organizations will meet to discuss this matter and report back to the executive and to you. So you may expect later on to have a definite report as to the possibilities of forming a central electrical organization and the basis of its formation.

These are the points which I wished particularly to call to your attention. Any other matters which have been dealt with will be brought out in the reports of the committees.

Let me add this thought, gentlemen. What we need at the present time more than anything else is closer co-operation among all of the municipalities forming this organization. A short time ago it was brought to my attention that one of the small municipalities did not care to join us because its representatives felt that it would get nothing out of membership. I think that was a mistake on the part of the municipality and was due to its people not understanding all of the conditions, for I think most of you will agree with me that everything has been done for the benefit of all municipalities and not for a certain group.

Nevertheless this incident shows that it is incumbent upon us to see that in future no municipality shall be able to say that it does not receive any benefit from membership in this Asso-

ciation. The municipality I referred to claimed that the conventions were solely for the benefit of the larger municipalities, which were reaping all the advantages from membership in the Association. We must always keep before our minds that we have all classes of municipalities in our membership, and therefore we must carry on our work for the benefit of all our members generally, and not for the benefit of any one group in particular. That means that we must co-operate to the fullest possible extent.

Gentlemen, in welcoming you to this convention I need only add that I hope you will enjoy your attendance to the fullest possible extent and that the proceedings will have a very high instructive value for you all.

The Nipigon Development

By T. C. JAMES, Municipal Engineer

Among the various developments serving the people of Ontario with electrical energy there are many features of interest from an engineering stand point. Thus we have the Wasdells development on the Severn River with a twelve-foot head, giving 1,000 horsepower capacity, but operating in parallel with the Eugenia development on the Beaver River with a 550-foot head—the highest head plant in Canada this side of the Rocky Mountains. Then there is the Chippawa development, the largest of its kind in the world, with which you are all so familiar. Lastly, there is the Nipigon development, ranking amongst the largest in Canada and the United States and, with the exception of the Niagara plant, the largest individual electric plant in the province of Ontaria.

Port Arthur and Fort William besides being the centre of a vast pulpwood district, located as they are on Thunder Bay where exceptionally safe booming grounds are accorded are the the logical sites for the location of the pulp-mills of Central Canada. Tributray to these sites on the east is a vast pulp-wood district available by river routes to Lake Superior and thence by rafting. This district is some 200 miles in length and from 50 to 100 miles in width. On the north is a similar district available by rail equally vast in area.

With the splendid quality of the water, free from all chemical impurities, together with the splendid quality of the fibre wood of the district, a combination which has gained for pulp manufactured at Port Arthur a reputation throughout the continent, there should be no hesitation on the part of the pulp and paper manufacturers in locating their mills on Thunder Bay in proximity to the Twin Cities. They would thereby be getting in ad-

dition other essentials—an adequate supply of labor, cheap power, and the best of transportation facilities for moving their finished products to the world's markets.

There are also possibilities for an excellent load at Nipigon village, located at the mouth of the Nipigon River at Lake Superior, with a very good deep water harbor on two transcontinental railways. This village, ten miles from the Nipigon development, promises a future of great possibilities. Already the Nipigon Fibre and Paper Company have located a mill at this point and have contracted with the Commission for 10,000 horsepower. They have constructed a 50 ton mill, which they are arranging to extend to a capacity of 100 tons. They have a 10,000 KVA sub-station. Power was first delivered to this concern in May, 1920, when a load of 4,000 horsepower was established.

The load at Fort William approximates to about 27,000 horsepower of electrical motor driven load, that is the connected load, and about 2,000 horsepower supplied by individual steam plants. This load is made up somewhat as follows:—

	horsepower
Pulp Mills,	8,000
Grain Elevators and flour mills	11,500
Iron and Steel Plants	2,500
Coal Docks	2,200
City Utilities, Lighting and street included	3,000
Canadian National Railway Terminal	800
Miscellaneous	1,000

This load is all being supplied at the present time by the Kaministiqua Power Company from a plant located at Kakabeka Falls on the Kaministiqua River, at which is installed some 30,000 horsepower Hydro Electric equipment. Power is transmitted to Fort William over three transmission lines at 22,000 volts.

The City of Fort William is under contract with the Commission at the present time to take power from the Nipigon Development at the expiration of their contract with the Kaministiqua Power Company in 1924. The Commission is arranging at the present time to serve the elevators and other concerns in the city approximately about 5,000 h.p. to be served over lines to be constructed by the Commission and to be taken over by the City at a later date when their obligations with the Kaministiqua Power Company have ceased to exist.

Port Arthur was originally served by a small development on the Current River within the limits of the municipality of some 2,000 h.p. capacity. This plant is still in existence and is being operated in parallel with the Nipigon lines for peak load purposes.

In 1909 the city of Port Arthur contracted with the Commission for a supply of power, which was in turn obtained from the Kaministiqua Power Company, and the City was served by this means until Nipigon power was first delivered in December, 1920.

The connected load at Port Arthur approximates 16,000 h.p. about 3,000 of which is served by individual steam plants. This load is similar to the load in Fort William, most of which is supplied to grain elevators.

The Commission was negotiating with two pulp concerns requiring 10,000 horsepower each when the slump in the pulp and paper industry forced these concerns to cease their activities. The Commission was also negotiating with another pulp concern requiring some 20,000 horsepower when this concern, for similar reasons, was forced to cease its activities. The Commission has also been negotiating with a smelting concern requiring from 15,000 to 20,000 horsepower. All told the future load of this district required by pulp and paper mill and melting industries approximates some 50,000 horsepower, based on negotiations which have already taken place.

This demand for power having become such that additional generating capacity was found necessary, the Commission, at the urgent request of the municipalities of the districts, Fort William and Port Arthur, has undertaken the construction of a development on the Nipigon River at Cameron's Falls, provision being made in the initial installation to take care of the immediate power requirements, and so designed as to permit extensions being made from time to time as occasion demands.

The construction of new terminal grain elevators, the possibilities of the mineral resources of the district, and the rapidly increasing loads in both cities were indicative of demands far in excess of the only existing available source of supply, the Kaministiqua Power Co., and the necessity for making provision for the immediate and future power requirements caused the local officials considerable anxiety. The solution of the problem was found after careful consideration, with the assistance of the Hydro Electric Power Commission, the ultimate result being the decision to proceed at one with the construction of the Nipigon development.

During the period of preliminary investigation concerning the future power requirements of this district considerable attention was given to a development at Silver Falls near Dog Lake on the Kaministiqua River, not far from the present plant of the Kaministiqua Power Company at Kakabeka Falls. This scheme was abandoned, however, owing to the ultimate capacity of the plant being only about 25,000 horsepower, and 17,000 horsepower for high load factor loads.

Neither the Kaministiqua Power Company nor the abandoned scheme of development at Dog Lake was capable of taking care of the high load factor loads, such as those of the Pulp and Paper Mills, to the same extent as the various sources of power on the Nipigon River, due to the much smaller drainage area and limited stream flow of the Kam River as compared with the Nipigon.

Nigeria has been added to the lands in which valuable deposits of coal have been discovered in recent years.

A single pull removes a new legging, which is attached to the wearer's leg by means of snap fasteners and a spring clip.

The Effect of Underloaded Transformers on System Power Factor

By G. F. Drewry,

Assistant Engineer, Hydro-Electric Power Commission of Ontario

IN the preparation of material for this article, one is compelled to take account of the requirements of an audience from a technical standpoint. I find it is practically essential to rely upon fundamental electrical principles in explaining certain phases of the subject. I might proceed in the contents by use of figures and statements without reference in many cases to how they are derived, leaving the reader to take my conclusions for granted, but I have chosen another course which, if it is successful, will give him far more satisfaction. I prefer to have him follow me by a course of reasoning to the conclusion. To accomplish this I am using various graphic representations of certain principles, which are familiar, and simple to some who may daily be using illustrations. To others these may serve to refresh their minds on principles which were included in their early training, but now only dimly recalled; and to others they will form a basis of understanding of what goes on in actual practical application.

Having chosen to take the course of making the results evident to the reader instead of stating them as facts I may have to broaden the scope of the some elementary principles not essentially required to cover the subject, but necessary to prepare some with a proper basis for understanding some of the results obtained, from conditions suggested by the title.

I shall proceed by first dealing with the action of transforming alternating current, and to explain this, I have resorted to the use of an illustration of the simple transformers. Figure 1.

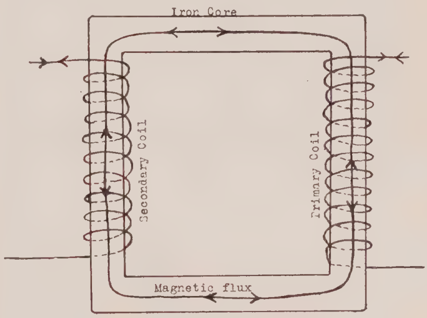


Figure 1

We are all quite familiar with the general mechanical make up of this piece of electrical apparatus. We all know that there is an iron core built up of thin sheets of special alloyed iron having desired magnetic properties. Some of you may know how essential it is to have this core built up most carefully, and compactly, and how necessary it is to prepare the iron by treatment of special nature to get those results, which are the

causes of high power factor when the transformer is underloaded. Some of you may know how the design, proportioning and etc. of this iron core plays so important a part in obtaining these desired practical results. I assume that these features regarding the design and manufacture do not come within the scope of the subject except in so far as the fact does exist that manufacturers produce apparatus differing in respect to those operating characteristics, which determine their affect upon power factor when underloaded.

Surrounding the laminated iron core we have the two windings, primary secondary, or high-voltage and low-voltage coils. In every transformer, whether of core type, shell type or other special type, the coils surround the iron in such a manner as to envelop the path of the total magnetic flow or magnetic flux, which is induced when voltage is impressed on one of the windings.

When a transformer is placed on the line, a balanced condition is set up between the voltage impressed and voltage induced, the study of which is unnecessary to this article. It is sufficient to know a flow of current in the winding connected produces this result. We are all familiar with the term "exciting current" as applied to the transformer and are more or less acquainted with its characteristics. In reviewing its characteristics I have resorted to the familiar graphic methods of illustrating it.

The following figure represents the sine wave of an alternating voltage impressed upon a transformer. The exciting current flowing in the transformer is also shown. The relation of the current with respect to the voltage is indicated. I have used the clock or victor diagram concurrently to illustrate more strikingly the power factor of such a load. The term load expresses the condition I wish to convey to the reader, because a common fallacy exists among central station operators or municipal superintendents that a transformer operating light on the system is of no consequence since it has no load on it. These figures show reation of current and voltage of a transformer connected to the line.

It will be noted that the exciting current is lagging considerably, being nearly a quarter of a cycle behind the voltage or almost 90% out of

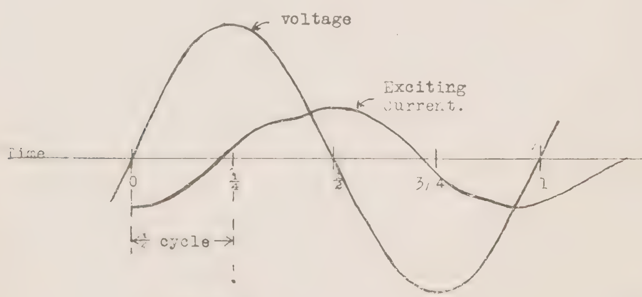


Fig 2 A

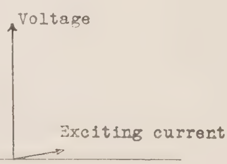


Fig 2 B.

phase. A load comprising a number of transformers connected to the line but operating light would have a very low power factor. The kilowatts required would be small, while the reactive kilovolt-amperes would be proportionately large. The following table gives information on transformers of standard make for distribution system use:

on the distribution transformers is ninety-five percent, some five percent having been conceded to exist in the secondary circuits, attached to the transformer. Let us also assume that the average exciting current of the distribution transformers varies in magnitude as indicated in Figure 3.

The power factor of the municipality's load as recorded at the trans-

TABLE NO. I

Table Showing Results of 25 Cycle Transformers Under No Load Conditions.

Size K.V.A.	Exciting Amps.	Watts No Load (losses)	Reactive Volt Amps. No load	Approx. Power Factor	Angle of Lag
2	.05 to .1	25 to 40	110 to 220	20%	78°
5	.1 " .175	40 " 60	220 " 375	17%	80°
10	.2 " .35	75 " 100	440 " 750	15%	81°
20	.37 " .55	120 " 160	800 " 1200	14%	82°
30	.5 " .8	175 " 225	1100 " 1700	14%	82°
50	.9 " 1.1	250 " 350	1900 " 2300	14%	82°

While it can readily be seen from a comparison of columns three and four of the above table, that the reactive Volt amperes or wattless load exceeds the watt load, this condition alters as a load is placed on the transformer. If the power factor of the load connected to the transformer is high, such as obtained from lighting circuits or domestic appliance loads, the affect of the exciting current is rapidly improved.

In order to comprehend the probable results that might be encountered in distributing power to users in a small municipality having a lighting load, let us assume that the probable average power factor of the demands

former station or generating plant under such assumed conditions will depend upon—

1. The transformer capacity connected to primary distribution lines and its ratio to the municipality's maxmum load.

2. The sizes of transformers used.

The first condition may be expressed as the degree to which the transformers are underloaded. The second condition assumes the possibility that there may be many small transformers or several large ones, used to transform the load.

The following table, compiled, shows the power factors of a municipal lighting load of 100 K.W. for var-

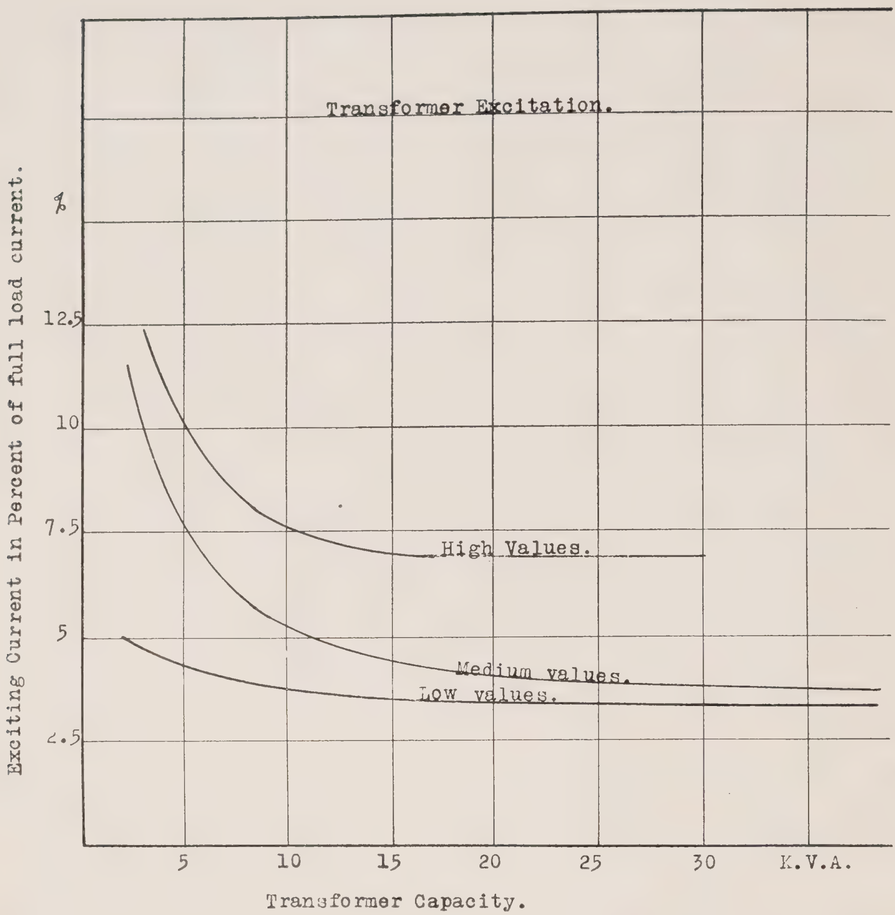


Figure 3

ious probable assumed conditions. The transformer capacity is assumed to illustrate the affect of the first condition mentioned above. The tabulation also shows the affect of using small transformers as compared to large sizes. Account is also taken of the fact that greater K.V.A. capacity is required where small sizes are prevalent, as diversity of smaller served areas is lower. Any intermediate condition from the one extreme of having excessive over capacity in small sizes to a low capacity in large sizes may be encountered. The power factor of the load on the secondary circuits is assumed to be 95 percent as mentioned above. Losses of distributing power are neglected in order to simplify the computations.

TABLE NO. II

Table Showing how Combinations of Distribution Transformers affect the Power Factor, on a 100 K.W. Municipal Lighting Load (95% Secondary Power Factor Assumed)

Transformers	Small	Sizes	Large	Sizes
Condition of Trans–ormer Loading	Normal	Underloaded	Normal	Underloaded
Transformer capacity connected	200	400	150	300
Station power factor	88.5%	81%	93%	90.5%
Power factor decrease due to Dist'n trans	6.5%	14%	2%	4.5%
" " underloading		7.5%		2.5%

Underloaded transformers represent a condition of 50% of normal loading.

It would be natural to follow such a review as above with a condition of supplying a 100 K.W. in power. It might be reasonably assumed to consist of several small power loads, the summation of whose individual maximum demands might amount to 150 K.W., but owing to diversity the municipal power peak would not exceed the above assumption. It can readily be imagined that the individual distribution transformer requirements might have been determined in error with the probability that too much capacity is available. It would be reasonable to expect that some allowance had been made for growth of loads due to contemplated extensions of industries. One might encounter the probability of having excessive over capacity in the power bank serving an industry suffering from depressed business condition frequently met with at present. Usually small miscellaneous power loads of this nature have a low power factor for reasons with which we are all familiar, and I may not be criticized if I assume the power factor of such loads as low as 80%.

Table III., page 8, is an effort to show the effect of underloading the transformers required to supply these power customers. I have assumed that due allowance must be made in the normal transformer requirements to supply these loads at the above power factor. With underloaded transformers, my assumptions are purely arbitrary, but not uncommonly found. I might admit that sometimes circumstances account for the conditions existing, but I desire to indicate the consequences with a view to possibly impressing upon you the necessity to eliminate every case possible.

We usually find any municipality with a lighting load of 100 K.W. has a power load also. There is no natural relation between the power for industrial requirements, and the lighting requirements of any municipality. It is recognized that where there are

industrial centres there is labor required, and lighting for domestic and commercial use is naturally required. We may find a municipality with a large industrial load having a day peak equal but have a varying power factor. It will also indicate the results of idle power transformers on the line during evening load and the opposite condition during day load.

TABLE NO. III

Table Showing how Underloaded Power Transformers Affect the Power Factor of a 100 K.W. Municipal Power Load.
(Assume Average Power Factor of Loads at 80%)

Transformer Capacity Connected	187½	250
Condition of Transformer Loading	Normal	Underloaded
Station Power Factor	76%	74.5%
Decrease in Power Factor		
due to transformer banks	4%	5.5%
" " underloading		1.5%

whose lighting requirements are small. On the contrary the municipality may have a lighting peak. We are not able to analyse all conditions but to indicate some conditions we might follow to a conclusion the analysis of a municipality with a combination of lighting and power loads as assumed in the two separate conditions above. The day and night loads would be

As such a municipality would be billed on the day peak, the penalty for low power factor would, under the worst circumstances above assumed, be 47.5%, while under normal circumstances the penalty would be 22.5%.

TABLE NO. IV

Table Showing how Underloaded Transformers Affect the Power Factor of a 100 K.W. Municipal Power and Lighting Load.

	Power Load		Lighting Load	
Station Demand	100 K.W.		100 K.W.	
At Secondary Power Factor	80%		95%	
Transformer Capacity	187½	250	150	400
Condition of Transformer Loading	Normal	Underloaded	Normal	Underloaded
Station Power Factor	73.5%	61%	89.5%	75%
Decrease in Power Factor				
due to transformers	6.5%	19%	5.5%	20%
" " underloading		12.5%		14.5%

The exciting current of a transformer will vary in magnitude under different operating conditions. As this

has a direct affect upon the power factor conditions of the system, it is worthy of some reflection at this point in order to prepare us for the results of experience cited in a later part of this article. I have represented the effect of a variation in impressed voltage upon the exciting current of a transformer, by a curve showing the percent excitation plotted against percent voltage. This curve is the familiar saturation curve of the transformer. At low voltages the excitation is excessive. The increased excitation for given increment of voltage is greater at higher voltage, increasing as the voltage increases, all of which is graphically illustrated in the saturation curve (Fig. 4).

We all know there is voltage variation on any system which finally reaches some undesirable amount before a comprehensive or radical alteration in plant lines and stations becomes imperative to render service which can be tolerated. This altera-

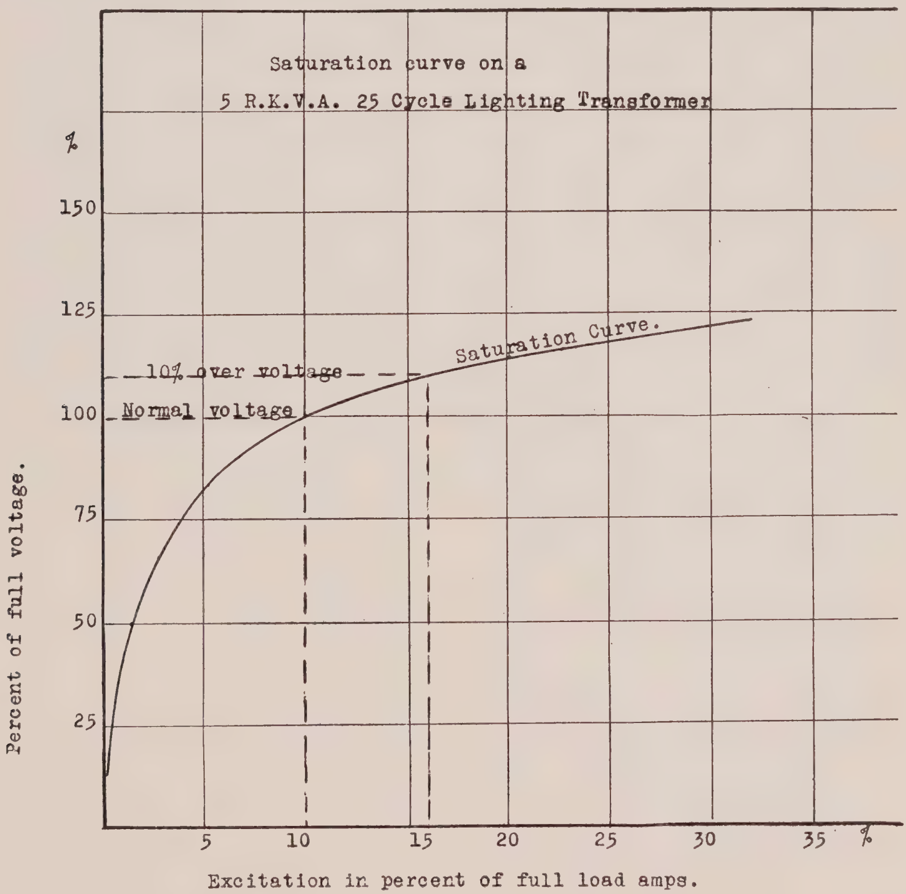


Figure 4.

tion is avoided for economic reasons in most cases, it being preferable to accept the poor service at a low cost rather than a good service at an excessive cost. In attempting to partly or totally correct such undesirable conditions, the practice of resorting to use of taps follows. To secure a normal voltage during low voltage periods of the 24 hour cycle, through which the voltage variation is experienced, the transformers supplying lighting loads or power loads are altered to boost the voltage by the use of the taps as circumstances may require. During high voltage periods of the 24 hour cycle such transformers have over normal voltage impressed upon them. This will result in excessive exciting current on these transformers, when they are lightly loaded. It may be contended by some that these transformers so operating do not affect the peak load of the municipality in which they may be located, since the peak would probably occur at a time when these were loaded, and when low voltage existed with normal excitation resulting from adjustments made by use of taps. Whether this may be the case or not, it must be conceded that these transformers during such periods of the day when excessive excitation exists, add to the probable high wattless load of a system supplying them, making it the more difficult to render good service and good regulation.

TABLE No. V.

	Power Load		Lighting Load	
Station Demand	100 K.W.		100 K.W.	
Voltage	Normal		10% low	
Secondary Power Factor	80%		95%	
Transformer Capacity	187½	250	150	400
Condition of Transformer Loading	Normal	Underloaded	Normal	Underloaded (taps used)
Station Power Factor	71.5	55.5	90.5	77%
Power Factor Reduction due to underloading (see Table IV.)		12.5%		14.5%
" " use of taps	2%	5.5%	–1%	–2%

Let us refer to the conditions assumed in the previous Table IV. where the municipality had a power load of 100 K.W. and a lighting load of 100 K.W. If voltage is low on the system supplying this municipality during night the practice of resorting to taps would follow. Assume for purposes of illustration that a 10% boost is necessary on all the lighting transformers on this account. During daytime the voltage is normal on the system, but 10% high on all the lighting transformers. The municipality would have such conditions as in Table V.

It will thus be seen that the correction for voltage regulation by use of taps is a serious operation which may result in materially increasing the power bills of a municipality. It would appear evident that such a procedure should be well studied before undertaken.

While I have only shown by the above Table V what happens in one specific circumstance when taps are used to adjust the voltage, there are many occasions arising on which a change of taps corrects the situation temporarily only to later find that such action has caused some such condition as above. While the changing of taps may be justified, it should be the endeavor to return to normal as soon as conditions warrant it. The main criticism seems to be in the fact that there is not a systematic check and correction of the conditions resulting in excessive excitation in some municipalities. The introducing of the conditions of over voltage on transformers in this paper appears proper, as the results of such on power factor are similar to underloading of transformers, and conditions found in some municipalities are due to a combination of both. If 10 per cent increase of voltage upon a transformer results in adding 50 to 60 per cent excitation, and transformer R.-K.V.A., the efforts of a designing engineer in attempting to reduce the power factor by keeping the transformer capacity to a minimum would soon be offset.

I have dwelt at some length upon the principles underlying the subject. I have taken step by step hypothetical circumstances which show certain results, on assumptions comparable with actual conditions. I now prefer to review some actual records to impress upon the engineer what he may expect when he investigates his own work.

In compiling the following Table VI, I have taken a few of many conditions that are daily being recorded. I do not wish to pass without mentioning the value of graphic records of municipal loads. Especially useful are the R.K.V.A. charts in a study of this subject. It would appear that we are often not as familiar with these records as we should be. Many utility managers may be devoting every effort to make the best possible financial showing in the operating of their utilities by reducing operating costs, increasing the revenue, etc., but in all they may fail to find as fruitful a field for their efforts as in studying these records for a possible reduction of power bills by decreasing R.K.V.A. due to transformer capacity on the lines, or excessive excitation due to over voltage. I found it was a little difficult to account for some of the conditions noted, and recorded in the Table VI. There are many circumstance which unwittingly throw one off the trail in such investigations, so that many municipalities which might show effectively excessive R.K.V.A. due to transformers, have to be passed by owing to existing complications. In 25 cycle systems the conditions were much more striking, and greater care should be exercised on this account.

I have found that accurate data is necessary in every instance to determine the transformer R.K.V.A., or to eliminate all R.K.V.A., except that due to transformers. The larger the municipality or municipal power peak, the more complicated is the circumstances. Power loads at primary voltage, synchronous condenser equipments, etc., affect the deductions. It would also appear that the smaller the municipality the greater is the pro-

bability of meeting with excessive R.-K.V.A. due to transformers. The column giving Transformer R.K.V.A., when compared with the total Transformer K.W. Capacity, indicates the percent excitation which varies over a considerable range. In explanation of this I can only say that there must be a considerable difference in the exciting current taken by different makes of transformers, a considerable range of voltages under which they operate, and possibly an appreciable difference between the exciting current of old and new transformers. In the last column I have shown the amount of percent reduction in Power Fractor contributed to the transformers R.K.-V.A., a portion of which might have been avoided where excessive exciting current or underloading of transformers is evident.

A study of the circumstances connected with an actual experience which recently came to my notice, is in order here, as it will assist in making clearer the importance and magnitude of the effect of underloading transformers. The incident happened in a small municipality where the lighting load is small, as compared with power loads that have existed in past years. Even at present the Municipal peak is sometimes a day power peak. A large bank of 90 KVA capacity in transformers had been erected in former years to supply a large power load. This bank was disconnected after the power supply was discontinued, but was left ready for reconnection in anticipation of again securing the load. The bank was recently put into service again to supply a small power customer in the vicinity, with the consequence that the municipality occasioned a peak with a considerably reduced power factor. Records indicated that 16 R.V.K.A. was added when this bank was reconnected to the line. There was already 12 R.K.V.A. due to 63 K.W. of transformer capacity of miscellaneons sizes for lighting and small power supply. The Municipality was billed recently for a peak of 36.8 K.W. at 20.20O'-clock, when the R.K.V.A. was the sum of the two above amounts, viz. 28, which gave a power factor of 79.6%. The R.K.V.A. of the municipality might have been at least 16 less than recorded, with the result that the power factor would have been 95%. The bill for power purchased might have been reduced 13% for the month in question, and in this instance the actual amount which could have been saved was approximately $30.00.

The charts of K.W. and R.K.V.A. on the above occasion are here reproduced in Fig. 5 as they are interesting to study. I have also produced the R. K.V.A. of a previous occasion, before the transformer bank was reconnected.

In delivering power to a number of municipalities on a system, the conditions found to exist on a municipal distribution system reoccur. We have the parallel condition where lines radiate from a 110,000 volt high tension transformer station to a number of 26,000 volt municipal stations. The high voltage station will have sufficient capacity to take care of growth in load and each municipal station will be installed upon similiar assumptions.

TABLE VI.—SHOWING SOME ACTUAL CONDITIONS OF TRANSFORMER LOADING, AND ITS EFFECT ON POWER FACTOR.

No.	Power		Light		Trans.	A Municipal Peak			Power Factor Reduction due to Trans.	Remarks.
	Trans. K.W. Capacity	Demand K.W.	Trans. K.W.	Demand K.W.	R.K.V.A.	K.W.	P.F.	Time		
1	60	58.8	18.5	13	16	58.8	72	16.30	10	High exciting current
2	100	60	215	85	45	103.4	80	20.00	15.5	
3	150	100	70	45	30	109	80	11.40	14.5	
4	650	260	225	85	80	306	77.5	8.30	10.5	45 K.W. in motors at prim. volt.
5	225	80	90	80	50	110	76.5	16.00	16.5	High Voltage.
6	2640	900	565	365	520	986	73	10.40	20	Large power bank lying idle.
7	895	350	220	175	200	363	74	11.30	16.5	Large power bank lying idle.
8	8500	8000	7000	5900	2200	12100	80	11.50	7	Includes 10,000 K.V.A. of high voltage trans.
9	90	60	55	35	7	74	78	15.00	3	
10	950	650	320	230	72	636	79.2	9.40	6.8	
11	1050	500	345	350	280	672	80	11.30	15	

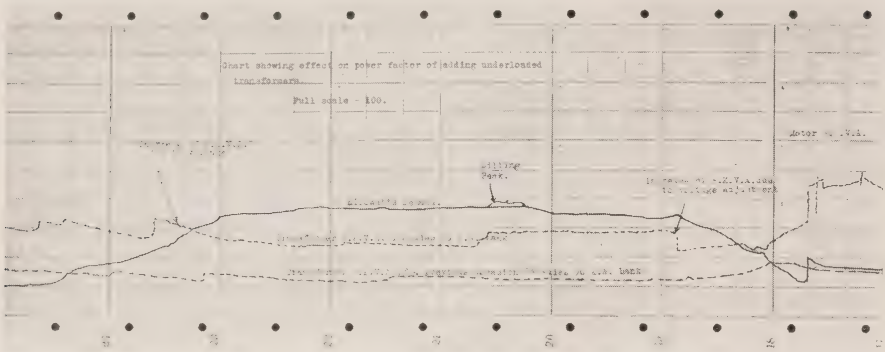


Figure 5.

The capacity of the individual municipal loads, would accordingly have a greater aggregate capacity than the high tension station supplying.

One area served by a 110,000 volt to 26,000 volt station is known to have the following conditions. High tension station operating capacity is 7500 K.V.A., while the aggregate capacity of the several municipal stations is 10,750 K.V.A. The maximum load on the high tension station is 6000 K.V.A. One month's records show a peak of 5000 K.W. at 84 percent power factor, on the high tension station. The aggregate of the individual loads served was 5200 K.W.; the power factor of this load delivered from this station was reduced 2.5% by reason of the 10,750 K.V.A. of 26,000 volt transformer capacity. One percent of this might be said to be attributed to underloading of transformers in the municipal substations.

If a similar condition should be found on the 110,000 volt distribution of power, a further reduction attributed to underloading results. The magnitude of this reduction would not materially change, but it would be found to be less in large capacity transformers, as they have a lower percentage of exciting current.

Summing up the conditions in a general way without endeavoring to become too exact in calculations, one might expect to find such general results in a power area or electric system as the following.

	Percentage
Power factor reduction due to underloading of distribution transformers on 4000 and2200 volt lines	2.5 to 18
Power factor reduction due to underloading of substation transformers on 26000 volt lines	0 to 1
Power factor reduction due to underloading of distribution stations on 110,000 volt lines	0 to 1
Power factor reduction due to underloading of stepping up station at generating plant	0 to 0
Total power factor reduction due to underloading transformers on a system	2.5 to 20

On any large system there is a multitude of conditions, and if the worst conditions outlined in this paper were generally prevalent, it would be very difficult to render satisfactory service. The magnitude of the effect of these undesirable conditions becomes evident to us because the possibility of the greatest range of reduction appears at the ends of the system on the 4000 volt or 2200 volt lines, and would require increase in capacity of plant, lines and stations throughout the system, back to the generating plant. Fortunately we are able to off set these conditions without increasing the plant capacities throughout the system. We have the well known method of operating a synchronous condenser on the line at any point where the maximum economic and practical effect can be produced. We have synchronous motors of small capacity situated at a suitable point. We have the condenser capacity of the transmission system and all apparatus connected to it. This is of considerable magnitude on a large system. On account of these, the effect of underloading of transformers is neutralized to a considerable extent.

In conclusion I feel inclined to point out the importance of securing distribution transformers with a minimum of excitation. The lower priced article might easily be the more expensive to operate. The manufacturer has been accustomed to producing a distribution transformer with low losses at no load. The importance of having a low excitation has not been given the same attention, probably because the designer has endeavored to meet the demands of a field of use where K.W. cost of production is high and K.V.A. production is of lesser importance, such as in steam generated power systems.

The central station or municipal engineer should be continually on guard against the possibility of conditions such as I have outlined in this paper. He is aware that his power bill is directly affected by these conditions, not to mention the extent to which he is responsible for the character of the service that can be rendered from the system. It should be his aim to keep closely in touch with the loading of his transformers and if possible improve their load factor. Care should be exercised in securing a good article from the manufacturer. The more distant his municipality is situated from the supply the greater is the necessity to closely scrutinize these conditions, since the costs and loss resulting are comparably greater and the service is more affected. These conditions are more likely to exist to a greater degree in the smaller centres as there can not be the same density of load. Neither can there exist as high a load factor where the cost of power is high, because there is no doubt a considerable improvement in the load factor of the lighting transformer due to the introduction into the home of the many electrical appliances which are becoming daily more familiar to the public, but are limited to economic use in the districts of lower cost of power.

Time limits one to a narrow study of this subject, and I feel in closing

that in some respects the paper does not do justice to it. I have no doubt there will be many who in reviewing their experiences will recall some occasion where there might have been improvement had a little care and good judgment been exercised. There are many practical occasions where the subject applies and where a considerable loss has been occasioned which might have been readily eliminated.

DISCUSSION FOLLOWING MR. DREWRY'S PAPER

Mr. Buchanan (London): Mr. President, Mr. Drewry has rendered us a real service in presenting a paper of this kind. The matter of underloading and of using taps is some thing that each of us should study very carefully. I do not believe that we had realized its full effect

However the matter of different exciting currents on different makes of transformers, as Mr. Drewry pointed out is something that we municipal managers have not much control over.

As the Hydro-Electric Power Commission have helped us very considerably by working out specifications to produce the most economical lamp, why don't they do the same thing for transformers, so that when buying transformers we can say to the manufaturer, "We want transformers to the Hydro-Electric Power Commission's specifications"? That would really be all that we would need to bother about.

J. Showalter (Westinghouse Company): Mr. Chairman, that is a real good idea. The Hydro-Electric Power Commission have some very good transformer engineers who probably know as much about transformers as the engineers employed by the manufacturers, and I think it is a very good suggestion that the Hydro-Electric Power Commission should adopt standard specification.

Standard specifications are set forth by the National Electric Light Association, under which most manufacturers work, and I think the Hydro-Electric Power Commission might themselves do something along that line, to meet their needs, the needs here being different to those in the States. It is only lately that low exciting current has been noticed and that salesmen have been talking of that feature of their transformers.

Mr. R. T. Jeffery (H.E.P.C. of Ont.)ff Mr. Chairman, Hydro-Electric Power Commission have been studying this subject and are getting out standard specifications for transformers, and I believe those specifications will be ready very shortly.

Mr. C. A. Baker: (Westinghouse Company): There is one point, Mr. Chairman, in Mr. Drewry's excellent paper—he says that the lower priced article might easily be the more expensive. That is absolutely right. But don't let us go to the extreme of trying to save in one place and lose out in the other.

Supposing we have a transfomer of, say, ten per cent. exciting current, to bring that down to five per cent. exciting current may add three or four or five per cent. to the cost of the transformer, but to bring it from five cent. down to two or three per cent. will add from fifteen per cent. to forty per cent. to its cost.

The main advantages to be obtained from reducing the exciting currents were brought out in Mr. Drewry's paper, and, as he stated, when you are down to less than five you have pretty well reached the economical limit for ordinary sized transformers.

The biggest gain probably results from keeping transformers as near as possible over half-load. To keep them from quarter-load up to say a ten per cent. increase over that is a big gain, but with ten per cent. increase on your half load the per cent. gain is less; and after we have passed half loaded the per cent. gain less; and after we have passed half load we are closely approaching a flat condition. We have not come to a flat condition yet.

These points I think it is well to keep in mind in considering this paper, and I trust the Hydro-Electric Power Commission when drawing up their specifications will fully consider the amount of the exciting current and not make it too low, because you have to dig too deep into your pockets to pay for your transfoimers. It is a balance between whether it is wise to pay a great deal more for your transformers or to save a great deal on your power bill.

Mr. A. B. Cooper (Ferranti Meter and Transformer Co.): The problems peculiar to the Hydro are peculiar to the Western Ontario section, and under the various conditions as summed up in Mr. Drewry's paper the design of the transformer would appear to constitute a really minor factor, but those conditions constitute a large factor by virtue of underloading and of overexcitation due to operating at high voltages.

Mr. Drewry in his sketch of the transformer showed just the fundamentals, but he left out the most fundamental of all the fundamentals—that is, the transformer insulation did not appear there. If the transformer manufacturers were all given certain specifications as regards exciting current and insulation charcteristics, they would all emerge fairly close to exactly the same transformer I believe. I think Mr. Baker will probably agree with that; he has had a great deal of experience in designing transformers. If we start drafting our specifications with the idea of getting down the exciting current and lose track of everything else, we are going to be called upon to develop very special transformer instead of standardizing on one type. In other words, we will have a transformer suitable only for certain sections of the Hydro, and not suitable to other parts of Canada.

I should like to suggest that if any movement for standardization is made further than we already have—and I think it is quite proper that there should be—it should be handled by the Canadian Engineering Standards As-

sociation at Ottawa. They have been organized under Government control, and the Hydro is represented among them.

As a consideration from the opposite side of the fence, in working closely to the line on the capacities installed, we run into the danger of cutting down the overload capacity of the transformer and consequently of break downs from overloading.

MR. E. I. SIFTON: (Hamilton): I am afraid, Mr. Chairman, that in the discussion there is possibly too much neglect of the conditions under which we buy power. The only thing we worry about is our 20 minute peak which occurs once a month. That occurs in Hamilton usually in the evening when the lighting transformers are carrying 125 per cent. load and some of them are 100 per cent. overloaded. The conditions prevalent under that loading is what we are interested in.

If you travel back to the Ontario Commission's load, as we have seen in the recent issue of their Blue Book just received for the year 1920, their load factor is pretty near 100 per cent. 24 hours a day on certain power plants, and certain other loads are purchased by them.

The load throughout the day affects certain municipalities, because they may run their peak for the month in the day time; other municipalities run their peak in the evening after five or six o'clock. In a word, we have to study our own local conditions and look after our own interests. In doing so we hope to work out everything to the general benefit of all; in other words, I thoroughly approve of co-operation.

The specifications for a transformer have got to be worked out, but we must know whether we are talking about no load conditions, 25 per cent. load conditions, 50 per cent. load conditions, or 100 per cent. overload. We try not to allow such a condition as 100 per cent. overload to exist, but it has occurred several times to my own knowledge on various systems besides Hamilton's.

Now, the question of exciting current goes further than the question of the transformer. It might surprise you to know that it costs us in Hamilton with our 23,000 meters a little over $1,000 a year to excite the meters. It is surprising if you buy a good meter how low the exciting current is, and the actual meter-exciting current is worth considering in buying meters. The exciting current on transformers —I am speaking now of exciting current at our ordinary rate on house lighting—is an important matter if you are billing everybody on a killowatt rate, but it is of very minor importance when you get down to the question of your peak load, the time that you have to pay for; and get effi-

MR. D. E. CHARTERS: (Windsor): Mr. Chairman, in regard to the scheme that is going to be carried out in the designing of transformers, suppose a customer to-day is asking for a transformer, he wants service—he wants voltage, he wants good light, and in some municipalities there is a large range load.

With regard to transformer capacity, take a 25 killowatt transformer and meter it, and you will find two periods in the day, running from 30 to 40 minutes, when it will be carrying 33 kilowatts, all the rest of the day its load will vary but the ordinary load will be about 8 killowatts, and therefore that means a very large transformer capacity which is not used. Take where there is probably one range to, say, 8 customers. That necessitates a large transformer. So I would suggest that in respect to customers asking for more voltage that consideration be given to the secondary voltage.

Kilovolt Ampere Measurement and its Effect on Power Factor

By S. L. B. Lines

Broadly speaking the power factor at which a municipality buys power, is caused by two conditions.

1. The exciting current of the distribution transformers.

2. By the loading conditions of the various customers.

The distribution transformer situation has been very ably covered by Mr. G. F. Drury in the Paper which preceded this It is the purpose of this Paper to deal with some of the factors connected with Conditions 2.

For the purpose of simplifying the analysis we will divide the customers into three very general classes.

Residential,
Commercial,
Power and Industrial.

The residential customers' load is almost entirely of the non-inductive type, *i.e.*, cooking, heating and illumination, all of which give good power factors. Fans and small utility motors form an exceedingly small portion of the total load. Therefore this type of customer in general tends to improve the power factor, rather than create bad conditions.

The commercial customer is primarily a lighting and heating customer but may have motors of a sufficient total to adversely effect the power factor. To determine whether this be the case or not, it is necessary to study the individual load.

The power or industrial customer is the one usually responsible for bad power factor. The extent to which this is the case is not generally realized. An analysis recently made in a 60-cycle district showed the power factor of the average machine shop to be between 60 and 70 per cent. at maximum load.

It is the practise of the Hydro-Electric Power Commission to bill munici-

palities on 90 per cent. of the maximum demand in watts if the actual power factor is below 90, if above 90, on the maximum demand in watts.

Some actual bills to municipalities within the past six months show what an effect this has on their monthly statement.

Municipality A.

Bill without power factor correction	$413.00
Bill with power factor correction	$477.50
Increase	$64.50

Municipality B.

Bill without power factor correction	$ 3,860.00
Bill with power factor correction	$ 4,760.00
Increase	$ 900.00

Municipality C.

Bill without power factor correction	$18,930.00
Bill with power factor correction	$21,300.00
Increase	$ 2,370.00

Municipality D.

Bill without power factor correction	$ 652.00
Bill with power factor correction	$ 766.00
Increase	$ 114.00

In analyzing the charts of "Municipality A" on the same day and time as that of maximum demand upon which their bill was based, we find they have an industrial load of 95.5 horse power at 80 per cent. power factor. If, however, the industrial load has been taken at 90 per cent. power factor this would have resulted in the total being taken at 87 per cent. power factor, or a saving of $51.00 per month. The conditions which increase the bill to this extent should either be corrected or passed on to the customer or customers responsible. Since, however, it is not usually possible by peace-persuasion to get the industrial customer to mend his ways, even if he can, the second alternative should be adopted, *i.e.*, pass the cost on to the customer responsible. It will I beleive be readily admitted that this should be done, as the only alternative is to charge all customers, good, bad and indifferent alike, a higher rate to cover up the sins of the few.

Some Municipalities have tried Methods

In some municipalities an endeavor has been made to do this in one of two ways, one to have testers visit the pre-

mises of the various customers from time to time and takes tests, the other, by means of two Graphic meters—one reading watts and the other reactive KVA.

The first method is better than nothing but the cost is considerable and it has the objection that one cannot be sure that the power factor at time of test is the same as power factor at maximum demand. Thus errors in billing may creep in either for or against the customer.

The following examples were taken on six customers in one of our large cities, chosen at random,—

Toy Manufacturer—

Demand .... 19H.P.
Power factor by periodic test...80%
Power factor by measurement...69%
Error 11%

2. *Leather Manufacturer*—

Demand .... 25 H.P.
Power factor by periodic test......45%
Power factor by measurement...45%
Error .... None

3. *Tannery*—

Demand .... 35 H.P.
Power factor by periodic test...71%
Power factor by measurement...86.6%
Error 15.6%

4.*Chocolate Manufacturer*—

Demand .... 45 H.P.
Power factor by periodic test ...85%
Power factor by measurement...74%
Error 11%

5.*Embroidery Manufacturer*—

Demand .... 25%HP..
Power factor by periodic test...85%
Power factor by measurement...91%
Error 6%

6.*Textile* N *Knitting Mills*—

Demand .... 550 H.P.
Power factor by periodic test...85%
Power factor by measurement...78%
Error 7%

Other municipalities however have neglected the question of power factor measurement and some results obtained in cases of this sort may be of interest,—

1. 16kilowatts demand. Power factor taken as 85%
   Test showed 47%
2. 190 kilowatts demand Power factor taken as 90%
   Test showed 66%
3. 90 kilowatts demand power factor taken as 90%
   Test showed 71.5%
4. 26 H.P. deamnd Power factor taken as 85%
   Test showed 54%
5. 22 H.P. demand Power factor taken as 85%
   Test showed 66.6%
6. 45.8 kilowatts demand power factor taken as 85%
   Test showed 57%

The second method, *i.e.,* using the two graphic meters, is so costly that it can only be applied to the very large customers. The question therefore arises, are there not some other methods by which one can make a just charge to each industrial customer? Let us compare the costs of the methods available at present.

Methods 1.

Two graphic meters as mentioned above, one to read watts and the other R.K.V.A. From these two readings

a power factor can be accurately determined. The cost varies from $385.00 to $780.00 according to the type of graphic used, plus transformer cost.

METHODS 2.

The use of two indicating demand meters connected as in Method One. This arrangement will give fairly accurate results, but since the maximum watts and R.K.V.A. may not coincide, due to fluctuations in voltage, an error may be introduced which would be unfavourable to the customer. The amount of the bill would no doubt be questioned. The cost of this method varies from $117.00 to $126.50.

METHOD 3.

The use of a graphic KVA. meter. This arrangement gives accurate results. The cost varies from $275.00 to $280.00.

METHOD 4.

An indicating KVA, meter giving accurate results and costing $72.00 to $79.00.

From the point of view of the cost and accuracy, the choice therefore rests between 3 and 4.

Method 3 should be chosen where a graphic record is required or justified. Generally speaking on 100 horsepower, or over, the expense is warranted. Method 4 is preferable where a graphic record is not justified.

We have arrived at the point where the instruments available make it highly desirable that both large and small customers be measured in KVA. It is now well, perhaps, to run over rapidly what is meant by KVA.

In a direct current circuit, kilowatts are the same as kilovolt amperes. In an alternating current circuit, this usually is not the case, because the question of power factor comes in. In this case watts equal volts multiplied by power factor (which is always less than one) whereas the volt amperes are product of the volts by amperes, neglecting the power factor. Therefore a volt ampere reading is always higher than a watt reading.

DESCRIPTION OF KVA. INSTRUMENTS ON THE MARKET AT PRESENT.

There are two types of graphic meters for measuring KVA. on the market.

THE INSTANTANEOUSLY RESPONDING METER.

"Intsrument A" is of the instantaneously responding type. It has the advantage of reading KVA, on balanced loads at any power factor but penalizes the customer on unbalanced loads. It is questionable whether this is a desirable feature or not. The Standard Interpretation of Rates and contracts by the H. E. P. C. at present existing, do not permit of a penalty for unbalance. Therefore this instrument should not be used unless it is known that the load is balanced.

This instrument has the standard form of metering discs such as are found in an integrating watthour meter. An intergrating wattmeter measures kilowatts because at the time the power factor departs from unity, the phase relation of the magnetic fields, (produced by the current and voltage cutting the meter disc) is changed. If the relation between these

magnetic fields is maintained on varying power factors, then the instrument will read KVA.

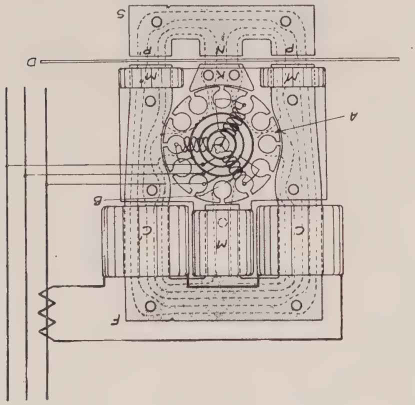


Figure 1

Figure 1 is an illustration of the magnetic circuit, shown in the single phase form for simplicity. The frame F is magnetized by the current coils C and C1. The potential element A is mounted in the space of the frame, so as to be free to rotate. It does not however, revolve like an armature of an ordinary meter but changes its position only with the changes of power factor. The potential element A carries a polyphase winding which when energized, produces a rotating field about its periphery. The flux of the frame divides, the major portion passing across the gaps between the frame and the yoke S, cutting the disc at P and P1. The remainder of the flux crosses the path formed by the potential element at N. There is a reaction between this portion of the current field and the potential field. Therefore the element A, which is free to rotate, will assume a position whereby the potential field is in phase with the current field.

A Rotating Element Maintains the phase Relationship.

If the power factor of the circuit changes, causing one of the fields to lead or lag the other, the potential element rotates enough to re-establish this phase relationship. The element A does not move except to shift in either direction with changes in power factor. However, a flux is produced by the polyphase potential winding on it which rotates about its periphery at synchronous speed. The path of this potential flux through the disc between K and N is at right angles to the potential flux path, from pole to pole through A.

The element A, always shifts so that the potential field is in time phase with the current field across the polar space, but with the element A, in this position the potential field across the disc between N. and K. will always be in time quadrature with the current field. This being the case, the torque on the disc is the same as if the power factor were maintained at unity. Therefore the instrument measures volt amperes.

Upon the spindle of the meter disc is mounted a pen which writes on the chart. This is similar to the arrangement in standard graphic instruments.

Description of the Demand Type of Meter

"Instrument B", is of the demand type and does not penalize the customer for unbalanced loads. It can therefore be used under any conditions, with the present wording of the contracts. It is limited however, in the range of power factor under which it

will operate accurately. In its standard form, it covers power factor from 43 to 90 per cent. lagging by the use of two sets of taps, but by the means of special taps it can be made to cover any desired power factor.

METHODS 4.

As far as the writer is aware, there is at present only one type of indicating KVA, outfit available. It employs the same principals as the second type of graphic KVA, Meter. The principal of operation is to apply to demand wattmeter a small external transformer. The purpose of this transformer is to bring the voltage and current in the circuit into the correct phase relation and to do away with the phase difference existing when the load is operating at power factors other than unity. It is immaterial whether the angular position of the current or voltage is shifted, as long as the two bear their correct relationship.

An inductive load causes the current to lag behind the voltage. If therefore we can cause the voltage to lag also, and by the same amount, we have the desired results and any standard wattmeter is caused to read KV-A, instead of watts. By means of the small transformer already referred to, the voltage is given the required movement backwards. The line voltage is applied to A.B. and C. (Figure II). Instead of C.B. being applied to the potential coil of the meter, 2-7 are connected for the one phase. Instead of A.C. being connected to the other potential coil of the meter, 7-5 is used. It will readily be seen from the diagram that this has shifted the voltage 53.13 degrees away from its original position. This angle is the same as the lag in the current with a load at 60 per cent. power factor and the meter will now read the product of the volts by amperes, providing the power factor under measurement is 60 per cent. Furthermore, the power factor of the load can vary very materially without introducting an error of more than 2 per cent. as is shown in Figure 3.

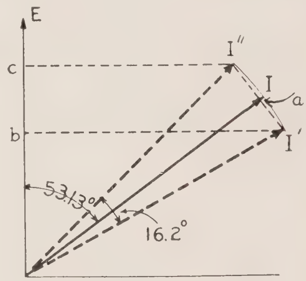


Figure III

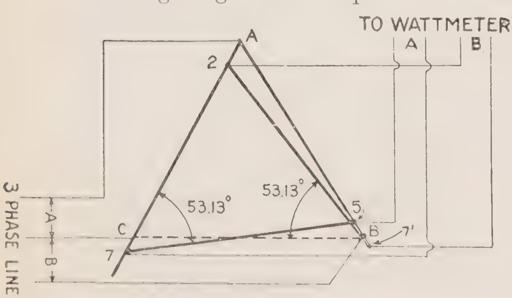


Figure II

Taps in the transformer, of which Figure 2 is a diagramatic sketch, can be taken out at various points and the voltage caused to be in operative harmony at any desired power factor.

COMPARATIVE METHODS

When the contract is based on a charge per horsepower plus an adjustment for power factor, the procedure would be as follows,—

Either measure the demand in watts obtaining the power factor from the

tester who has visited the factory, and work out the formula as follows,—

K.W. demand reading multiplied by .746 to convert to horsepower. Then multiply by the allowable power factor over the actual power factor.

It will be noted that both these multipliers increase the readings of the meter. To measure the customer in kilovolts amperes of demand, cut out the testing on the customers permises, with its uncertainties, and the formula then becomes as follows,—

$$\text{KVA reading} \times \frac{1000}{746} \times \frac{\text{allowable P.F.}}{100}$$

It will be noted in this case that only one of the multipliers increases the readings. The other decreases it. Although the results of both formulas are the same, the customers is not as apt to feel quite so badly dealt with as where both multipliers increase the meter reading. An actual example of each method shows that the results obtained are exactly the same. A customer with 60 kilowatt on his meter, whose power factor is found to be 50 per cent. on tests, would have his bill worked out as follows:—

$$60 \times \frac{1000}{746} \times \frac{85}{50} = 137 \text{ H.P.}$$

A kilovolt-ampere reading on the same customer would be worked out as follows;—

$$120 \times \frac{1000}{746} \times \frac{85}{100} = 137 \text{ H.P.}$$

Power should be sold on KVA, Basis.

I would at this juncture put in a plea for the sale of power on a kilovolt-ampere basis in place of horsepower plus a power factor penalty. The are no instruments measuring horsepower. They all measure in watts or volt-amperes. This fact means that the meter reading must be multiplied by a factor which increases the figure appearing on the bill. The power factor penalty means, first, that the power factor must be measured and, secondly, that a multiplier has to be used which again increases the reading. By the time one has finished with the average layman, he is properly fogged. I am sure he will go away with the impression that most electrical engineers ought to be in jail. Whereas if power was sold at so many dollars per kilovolt-amperes (instruments now being available to measure this quantity). The reading would be taken from the meter, multiplied by dollars and cents and the total bill arrived at without any further figures or multipliers. The objection may be raised that the customer will not understand what a kilovolt-amperes is. This same objection was raised to the change which took place on lamps. Carbon lamps were all sold by the candle power whereas lamps to-day are sold on the watt basis and our better halves talk just as glibly about 25 and 50 watts today as they did in the old days about 16 and 32 candle power. It would appear reasonable to assume that the individual customer would learn just as rapidly what a kilovolt ampere is as compared to the somewhat ambiguous term "electrical horse power".

May I point out that when a farmer, who has one horse doing a short time job, comes to install electrical power, he finds he has to have two of the

electrical variety to do the same work. Electricity is somewhat belittled in his mind right at the start. Whereas if he was told that he required two kilo-volt-amperes to do the work of one horse, he would be entirely satisfied. When his bill came in, if he were able to read the meter, his reading and the bill agree.

I will conclude by giving two sample bills together with the necessary calculations in each case;—

Load 100 H. P. at 50% P. F.

Watts Demand Corrected for P.F.

Price per H.P., $1.25.
Meter Reading, 74.6 K.W.
P.F. found by Test, 50%.

$$74.6 \times \frac{1000}{746} = \text{H.P.} = 100$$

$$100 \times \frac{90}{50} \text{ (to correct for P.F.)} = 180$$

180×price per H.P.=Bill.
180×$1.25=$225.00.

KVA Demand.

Price per KVA, $1.51.
Meter Reading, 149 KVA
149×$1.51=$225.00.

DISCUSSION FOLLOWING MR. LINES PAPER

The President: Gentlemen, I am sure you will agree with me that the papers we have had this morning have been very interesting. I might say that the use of this V.A.D. transformer with demand meter is becoming more or less general on certain types of loads. I do not know whether very many municipalities as yet have them in operation. In Walkerville we have in the neighborhood of nine demand meters with V.A.D. transformers now in operation on loads ranging from 100 up to 800 horsepower, and so far we have found them very successful, and the results obtained have been very satisfactory—from our viewpoint, not so much from the viewpoint of the customer. In one case we increased a man's bill $300 a month, on account of low power factor.

Mr. J. E. B. Phelp: (Sarnia): Mr. Chairman, I am sure we are all very much interested in the paper read by Mr. Lines. I may say on behalf of the municipality of Sarnia that we have adopted the use of the V.A.D. obtaining excellent results as far as this municipality is concerned.

I was also interested in that part of his lecture where he described the billing. I think that is a step in the right direction. I have always wondered why we should be bothered figuring out horsepower when all our electrical instruments register in kilowatts. I would like to see the selling of cur-

rent on the K.V.A. basis as described here to-day adopted as the standard.

MR. T. R. C. FLINT: (Toronto): Mr. Chairman, where the voltage is increased on the circuit, would it not affect to some extent the K.V.A. measured by such a meter as is being discussed this morning?

We have at the present time a meter that reads fairly accurately the kilowatts. It is an indicating type of meter. We have received some complaints, due to the fact that once the meter is re-set what you might call the proof of the reading is gone, and sometimes our meter reader has been seriously questioned.

We have been looking into this matter and in order to retain proof of the reading we have, through the Canadian Kodak Company, been able to procure a type of camera that will photograph the reading. If that is of interest to you gentlemen I may say that we have the camera on Yonge Street for your inspection.

MR. P. M. LINCOLN (Lincoln Meter Co.): This measurement of KVA as gotten out by this method gives the true KVA independent of the voltage. As the voltage increases the KVA increases in exactly the same proportion. It takes cognizance of changes of voltage so long as they are reasonably within the limits of the power factor for which the VAD transformer is set. Mr. Lines has shown that the angular variation may be 11½° each side of the setting before the error amounts to more than 2 per cent. Also, it is important to note that whatever error there is, is in favor of the customer; that is, if there is any error at all it reads lower, and cannot penalize the customer in any event. That is important because it cannot be attacked by the customer on account of the possibility of over-registering.

Mr. Drewry's and Mr. Lines' papers this morning have emphasized what one might call the two neglected factors in the making of rates for electrical service load factor and power factor. The load factor and the power factor are absolutely essential in the distribution of the cost of power equitably. It stands to reason that in distributing the cost of power to the users of power every user should so far as possible pay his just proportion of the cost. That, I believe, is the fundamental principle upon which the Hydro-Electric Power Commission is operating.

It follows from that that each class of customer should be assessed an amount which is his just proportion of the total, and a proper system of assessing the cost is essentially a system which will take into account the proportion of each user's cost to the total. And in making such an assessment I wish to emphasize again that the consideration of those two factors is absolutely essential—load factor and power factor; both of them must be taken into consideration before the assessment san be justly distributed.

MR. FLINT: We have many consumers, Mr. Chairman, who run 24 hours a day. There is no doubt that the system voltage is going to increase at night over what it is during the day. Assuming the consumer pulls the same amount of horsepower during the night as he does during the day, will

not the KVA at night be higher than during the day?

Mr. Lincoln: That is true, but the actual power demand at all periods of the day is the same. That is, the RK-VA portion of what he takes is increased, and therefore the KVA is increased. A watt meter is so constructed inherently that it measures the projection of the current on the voltage. (Mr. Lincoln then explains the action of a V.A.D. transformer by means of a diagram.)

Mr. E. R. Lawlor: (H. E. P. C. of Ontario): As the variation is very small, would not the error caused by the increased voltage be nullified by the error on the other side on account of the VAD transformer not registering exactly the KVA used?

Mr. Lincoln: That is probably the case, but the error would be offset by the fact that at night when the voltage is high the power factor is also tor, while the type of load you have at night is lighting and heating, which has inherently a high power factor load, while the type of load you have in the daytime, when motors constitute the load, has a low power factor. It has always been my feeling that the best way to get the power factor corrected is to pass on the cost of that power factor to the ultimate user.

The ultimate user in the application of his motors and transformers to his factory is able to govern his power factor to a very large extent by a judicious choice of his motors and other equipment, and if you put upon him a penalty for low power factor he will use a great deal more judgment in choosing that equipment, and he should use judgment so as to get his power factor up.

If you do not recognize power factor in your rates you do not give the ultimate user any incentive to correct his power factor, and consequently you are going to have conditions where your power factors are pretty low, and that, as far as I gathered from your discussion this morning, is what you have now—a condition where power factor is low, and there is no incentive on the part of the ultimate consumer to improve it. If you tap his pocket book he is going to correct that. I think that is the proper attitude to get him into.

Mr. G. F. Drewry: (H. E. P. C. of Ont.): I believe Mr. Lincoln did not quite get the phase of Mr. Flint's question, not being familiar with our conditions. Mr. Flint does not refer to a power customer having his service at primary voltage where there is transformer RKVA coming into account at all: he has reference to the increase the voltage would have on the RKVA of the motor, or the motor load. Of course that would not be as appreciable as it would be on the transformers.

Mr. Lincoln: That is true.

Mr. Drewry: The point, is that the customer will get a certain amount of penalty arising out of increase in voltage. Our duty as a supplier of power is to maintain a definite voltage. Sometimes it is a physical impossibility to secure that, but if you do not exceed a definite voltage you are not going to penalize your customer on power factor.

Mr. Lines has intimated that the KVA is a fine basis of measurement. Mr. Lincoln says that power factor penalty is the proper way to get restitution. Now, those two statements are more or less conflicting, because if you obliterate and put out of existence our common terms of kilowatt, power and horsepower, you will delete from the ordinary layman's mind the fact that he is a culprit in taking power at a very low power factor, and I think the old kilowatt and horsepower measurement cannot be lost sight of.

Further Progress of Rural Distribution

By J. W. Purcell,

Assistant Engineer, Hydro-Electric Power Commission of Ontario

THE tendency of the present times in rural districts is toward the uses of power in different forms for field work, in the barn, and to a lesser extent in the house.

The western provinces of Canada and the United States have for a long time used the tractor for field work, but have found the large tractor too heavey, too unwieldy, too cumbersome for their needs and for their soil; the natural result has been the discontinuance of the use of it to a great extent; the small tractor coming during the war has been adopted quite generally in the West and East. There have been, and are extremes in the applications—in the East we find farmers purchasing tractors and not reducing their number of horses on the farm—in the West there are men like Schaal and Schaal, twenty-five miles, southwest of Winnipeg, who operate 10,200 acres with no horses, and no stock, but forty tractors; each one hauls two to fourteen inch plows, and they plow an acre every 2 minutes 12foot drills seed 640 acres a day. In harvesting they cut and stook a section (640 acres) per day. Mr. Schaal, Sr., claims power cheapens production and increases profits by horseless farming.

We, however, are not interested in the sale of tractors excepting in the general application of power to farm work but we do think it is unfortunate that millions of dollars should be expended on this form of power, when by doing so they feel they are not justified in making a smaller expenditure to equip their places with Hydro-Electric power, which would give them a greater service both in the house and barn, at only a fraction of the cost per annum.

Our Ontario farmers, however, in most cases have not considered the needs in the house as serious until recently. The wives and women of the country have been granted the franchise, and apparently this has affected their status to the extent that they now enter into the discussions in many of the meetings, and are not

TABLE NO. I. WHAT THE FARMER'S WIFE DOES- AND WHAT SHE HAS TO DO IT WITH

	Rooms to care for	Stoves to care for	Kerosene Lamps	Water to Carry: Percentage	Water to Carry: Distance Feet	Wash and Iron	Sewing	Daily Mending Hours	Bread Making
	Average	Average	Percent	Percent	Average	Percent	Percent	Average	Percent
Eastern States	9.7	1.35	79	54	23	94	86	5	89
Central "	7.7	1.3	79	68	41	97	94	6	78
Western "	5.3	2.5	77	57	65	97	95	5	97
Average	7.8	1.6	79	61	39	96	92	6	94
No Records	9871	9210	9830	6611	6708	9767	9724	8001	9614

	Running Water	Power Machine-ry	Water in Kitchen	Sink and Drain	Washing Machine	Carpet Sweepers	Sewing Machines	Screened Windows & Doors	Out-Door Toilet	Bath Tub
	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent
EasternStates	39	12	67	80	52	58	94	95	87	21
Central "	24	29	47	52	67	46	95	98	93	18
Western "	36	22	18	44	49	29	95	91	86	23
Average	32	22	48	60	57	47	95	96	90	20
No Records	9320	9080	6949	9334	9472	9513	9560	9667	9580	9784

What the farm woman needs, says the Department of Agriculture, and what she can be taught to buy, is more labor-saving equipment. In equipment the farm home is far behind the field or even the barn, with the result that the farm woman's task is no easy one. the Department looks to manufacturers and advertisers to do their share in improving conditions in the farm home, just as they have Tinoher parts of the farm.

backward in stating their views. The following table prepared by the U.S. Dept. of Agriculture shows the distribution of the farmer's wife's work, and the equipment she has to do the work with. The notation at the bottom, by way of advice to manufacturers and distributors is a timely suggestion to the manufacturers, distributors and merchants in Ontario.

Shortly before the June convention of this Association, the Legislative Assembly of the Province of Ontario passed legislation authorizing the bonusing of rural power distribution primary lines whereby these lines would be bonused up to 50% of their cost, at the time they are constructed.

The Commission was advised that for the present the Province would bonus the primary lines to the full amount of 50%, so that all estimates sent out and rates given are based on this assumption.

Late last year the Commission found it was necessary to classify rural service, using as a basis for each class the demand of such class of service, based on the average demand from our experience in service to a large number in each class. The following excerpts from the letters to townships giving rates, gives the classifications and the description of the service each may be applied to, as well as the estimated service charge, the estimated annual cost, the class demand in k.w., and in h.p., the average monthly k.w.h., and an estimated total cost, based on power at 5 cents per k.w.h. for the first 14 hours use of the class demand, with a follw up rate of 2-1-2 cents per k.w.h. The Service Charge and total cost are given for both frequencies as there are some representatives here from districts using each, and it may be well to have these figures handy when your farmer friends come in to enquire about probable costs for service in your district.

Class I—Hamlet service includes service in hamlets, where four or more customers are served from one transformer. This class excludes farmers and power users. Service is given under three sub-classes as follows:—

Class I—A—Service to residences where the installation does not exceed six lighting outlets or twelve sockets. Use of appliances over 600 watts is not permitted under this class.

Class I—B—Service to residences with more than six lighting outlets or twelve sockets, and stores. Use of appliances over 750 watts permanently installed is not permitted under this class.

Class I—C—Service to residences with electric range or permanently installed appliances greater than 750 watts.
Special or Unusual loads will be treated specially.

Class *II.—House Lighting*—Includes all contracts where residences cannot be grouped as in Class I. This class excludes farmers and power users.

Class III—*Light Farm Service*—Includes lighting of farm buildings, power for miscellaneous small equipment, power for single phase motors, not to exceed 3 horsepower demand, or electric range. Range and motors are not to be used simultaneously.

Class IV—*Medium Single Phase Farm Service*—Includes lighting of farm buildings and power for miscellanieous small equipment, power for single phase motors, up to 5 horsepower demand, or electric range. Range and motor are not to be used simultaneously.

Class V—*Medium 3-Phase Farm Service*—Includes lighting of farm buildings and power for miscellaneous small equipment, power for 3 phase motors, up to 5 horsepower demand, or electric range. Range and motor are not to be used simultaneously.

Class VI.—*Heavy Farm Service*—Includes lighting of farm buildings and power for miscellaneous small equipment, power for motors up to 5 horsepower demand, and electric range, or 10 horsepower demand without electric range.

Class VII—*Special Farm Service*—Includes lighting of farm buildings, power for miscellaneous small equipment, power for 3-phase motors from 10-20 horsepower demand, and electric range.

Class VIII.—*Syndicate Outfits*—Includes any of the foregoing classes which may join in the use of a syndicate outfit, provided the summation of their relatives class demand ratings is equal to the Kilowatt capacity of the syndicate.

The estimates on the cost of power delivered to users as herein set out have been based upon certain assumptions, some of which are as follows:—

The construction of the lines shall be undertaken and paid for by the Commission. The farmers in the vicinity of the roads along which the lines pass will assist in the construction and assistance will be paid for at a suitable rate of wage. Lines constructed from the line on the highway to customers' premises will be paid for by the customer. The Commission proposes to supply the necessary expert labor to direct the construction of the lines and the installation of the equipment. It has been assumed that three farmers per mile of line, or the equivalent, are obtainable as an average for the entire district to be served. The supply of poles at low prices in the district or the vicinity of the district by efforts on the part of those desiring service will result in the reduction of the cost of construction and corresponding reduction in the cost of service. Co-operation resulting in the reduction of cost of construction is desired. The rates herein set out are also based upon a government bonus of 50% of the cost of primary lines constructed on the highway or along the right-of-way.

Charges for power delivered shall consist of two parts, namely, the ser-

TABLE NO. II.

Class	Demand Rating K.W.	Demand Rating H.P.	Average Monthly K.W.H.	Est. Annual Consumption Charge	25 Cycle Systems: Est. Annual Service Charge	25 Cycle Systems: Total Est. Annual Cost	60 Cycle Systems: Est. Annual Service Charge	60 Cycle Systems: Total Est. Annual Cost
I Hamlet Service.....	(a) 1/2	2/3	10	4.68	17.59	22.27	17.08	21.76
	(b) 3/4	1	15	6.84	20.50	27.34	19.74	26.56
	(c) 2	2–⅔	150	48.12	36.44	84.56	34.42	82.54
II. House Lighting....	1	1–⅓	15	7.92	30.05	37.97	25.40	33.32
III. Light Farm Service	3	4	40	21.60	60.82	82.42	55.76	77.36
IV. Medium single phase farm service	5	6–2/3	70	37.80	66.94	104.74	60.00	97.80
V. Medium 3 phase farm service......	5	6–2/3	70	37.80	84.50	122.30	76.04	113.84
VI. Heavy farm service	9	12	150	74.52	130.97	205.49	115.79	190.31
VII. Special " "	15	20	300	137.76	188.90	326.66	170.08	307.84

The above costs are calculated from our knowledge of the use of electric power in rural districts under average conditions. They have been adjusted by applying the rates as set out herein.

The rates will be re-adjusted by the Commission from time to time in your district to cover cost. Increase in the average number of farmers per mile or lower cost of power will reduce the annual costs to all.

vice charge and the consumption chage. The service charge which constitutes the greater portion of the total cost of power delivered, consists of the operating, maintaining and fixed charges of the lines and equipment required to deliver the power to the users in the district. Consumption charges will be determined by a meter at each customer's premises, which will measure the quantity of power used to which a suitable rate will be applied. This cost can only be arrived at when the amount used has been determined. The rate used in the district will be determined by the cost of power at the transformer station supplying the district . The power supplied to the district will be metered at the transformer station.

The meter rates for users in that part of your Township will be supplied from..
are estimated as follows:—

5c per Kilowatt hour for the first 14 hours use per month of customer's class demand rating

2½ Per Kilwatt hour for all remaining uses.
Less 10% for Prompt Payment.

The following table gives class demand rating, average monthly kilowatt hours, estimated consumption charge, estimated service charge, and total estimated annual cost for each class:—

Rural contracts have been developed to a form that agrees in principle and application to that which is in use in urban municipalities, excepting that in the former the liability is assumed collectively and benefits distributed individually through the municipality as a whole. Most service in rural districts is being supplied under Part II and part IIB of the Power Commission Act as supply to individuals, therefore the liability in a district is assumed by this group of individuals, and any benefits accrue to them as individuals. The rural power contracts are covered by a guaranteeing agreement between the townships and the Commission.

Under legislation as revised in 1920, all new systems will be operated by the Commission. Distribution in districts such as yours, from existing or provided distribution centers, make this desirable. At the end of each year a statement will be rendered to each township in each district.

Construction in rural districts was discontinued in 1917 on account of the war, and by reason of high costs and unsettled conditions was not undertaken again until this year.

At the end of the fiscal year 1920 the Commission had

Farm Services	1126
Hamlet Services	857
Suburban Services	4103
Suburban Service on local records, about	2000
Total	8086
Miles of line	502.74
Townships in which service is given	81

During 1920, however, the legislation regarding rural distribution was revised with a view to more extensive construction than had taken place before. During 1919 and 1920 pre

paratory surveys were made over a large area in 68 townships, divided as follows:

Niagara System	30
St. Lawrence System	14
Eugenia System	3
Severn	3
Wasdell System	7
Rideau	3
C. O. S.	6
Ottawa System	2

Based on these surveys districts were laid out and submitted to the Government for approval.

Rates were approved for these districts on the assumption that a Government bonus of 50% would be obtained and that the number of farmers signing contracts would not be less than three per mile.

The total number of townships includes by these districts, and the number of townships adjacent to load centres, which might be served from H.E.P.C. lines, is 341 and the area covered is 17,365 acres.

Authorization having been received with regard to these districts, meetings were advertised and held in all prominent centres, in order that the new procedure and rates might be explained to the residents of these townships. The first meeting was held on June 16, 1921 and to date the following meetings have taken place—

Niagara System	155
Eastern System	14
C. O. S.	20
Northern Systems	100
	289

At about 50% of these meetings committees were elected to carry on the work in the section covered by the meeting, including the making of the canvass for contracts; this has been the practice of the Commission for some time, the endeavors of the committees being directed by the engineer for the district, keeping their efforts concentrated to a definite route, to a distribution centre, which in most cases is an urban municipality now being served.

The basis of former estimates submitted on the receipt of a petition was the petition, with an appliancation of ordinary horse sense. This was in many cases found to be a wrong assumption— I do not mean the application of the horse sense—but the petitions did not represent the amount of business that could be secured when a canvass was made for contracts it was found necessary to establish a minimum amount of business as a basis for rates, to work from or to. It was also found that the 3 h.p. contract (Class 3) was more popular than the 5 h.p. contract (Class 4 or 5), as the total annual cost was less, therefore for the primary portion of this annual first charges they were put on the same basis and the minimum business referred to was placed at 3 of either of these classes per mile, or their equivalent, as an average for the district.

Under the legislation of 1920, distribution is made in districts or zones regardless of the geographical lines of townships. Under this more economical method of distribution it is possible to develop a system, where it was not possible as a township system.

The results of the meetings and canvasses by committees with the assistance of district engineers has been about 3500 rural contracts since June 10th, 1921, a large percentage being contracts for farm services, the balance hamlet and suburban services. Below is a list of rural construction approved, for which the bonus has been approved. Canvasses in many prospective and existing systems are not yet complete, and are being carried on by the local committees.

Construction is under way in quite a number of the districts approved, favorable fall weather permitting this (It is the policy of the Commission to avoid as far as possible winter cons- supplied to direct the construction and install the equipment.

Following is a list of rural systems and extensions under construction, or approved to construct.

Shortage of poles in Old Ontario has forced the Commission to underground construction for rural service. In 1921 less than half of the poles required were secured in Ontario, the balance coming from Quebec, New Brunswick and British Columbia. This is largely the cause of a great difference in cost of material for a standard

TABLE NO. III.

Rural Systems and Extensions under Construction, or Approved to Construct.

Systems	Rural Power District	Consumers	Miles of Line	Load–K.W.
Niagara	13	1198	168–35	2050.5
Eugenia	3	22	3.16	23.5
Severn	1	60	7.6	85.5
St. Lawrence	3	88	15.25	131.5
Wasdell	2	4	1.6	14.
Ottawa	1	76	18.61	194.5
	23	1448	214.57	2499.5

Rural Power Systems and Extensions Approved for Construction and Bonus Approved.

System	Townships	Consumers	Miles of Primary	Trans. Capacity K.W.	Total Estimated Cost	Bonus
Niagara	13	1094	173	1995		
Ottawa	1	78	18.61	204		
Eugenia	4	46	8.85	83		
Severn	1	99	17.75	158		
St.Lawrence	3	80	15.25	123		
Wasdells	1	4	1.58	14		
	24	1401	235.04	2577	$506,020.06	$146,867.16
Additional Capital applied for—					$ 75,479.44	$ 22,473.98

rural 3 phase mile of line, on poles, the range being from $383.52, for material only, in 1911, to $843.94 in 1921 approximately 50% of the cost of material per mile this year is for poles laid down. The Commission have laid out and have under way underground construction in the following township—

Salt fleet	55 miles
Beverley	3½miles
Ancaster	7 miles
Niagara	3½miles
Willoughby and Bertie	8 miles

part of this being 3 phase and part single phase, taking in all about 115 miles of cable. The cable is lead encased rubber insulated with stranded copper conductor. A trench is made, using plows, with a minimum depth 12 inch the cable laid in without a duct, the fill being made by using a scraper. The Commission, appreciating that load density is low, and construction must be under way in many districts at the same time, has endeavored as far as possible to use equipment which can be secured locally thus decreasing the cost. It is possible that methods truction of rural systems.) Farmers in the vicinity of the roads along which lines will be built, are assisting in the work, and are being paid for at the current wage of the district, foreman, linemen and wiremen being of installation may be changed as the work progresses. The obstructions that are met with in districts are tree roots, boulders, and soil conditions. It would seem, from progress reports, and estimates that 3 phase line underground will cost more than a similar line overhead, that single phase line underground will cost less than a similar line overhead, and that for a system with one-third three phase and two-third single phase underground, the cost of underground distribution would probably be lower than overhead. Most services from this system are overhead, transformers erected on a short pole at a suitable location for the service, or services and "run-offs" made to point of delivery to the premises.

This paper would not be complete without some reference to electric service in rural districts from other sources. The individual plant driven by gasoline engine with or without and store 1013 K.W.H. in the year. From our experience, the Class 3 constorage battery, is commonly known in Ontario, some having been installed for 9 years. These serve for lighting only; other uses, as a rule are a serious tax on most of these plants, and only result in impairing it for its most important use—lighting. By reason of the high depreciation of plant and battery, and the maintenance, the cost of service per unit of work or of electricity is quite high. Recently a pamphlet on Wind-produced electric power—not the "hot air" kind commonly used—but a plant driven by a windmill, came to our notice. It is manufactured in one of the Western States, costs $850.00 f.o.b. factory, has a capacity of 1.5 K.W., and they claim in that State would generate sumer uses an average of less than 500 K.W.H. per year. This amount of electricity in the average district as served by us, including all charges, would cost an average of 17.1 cents per K.W.H., and if supplied by wind service, would cost 55.7 cents per K.

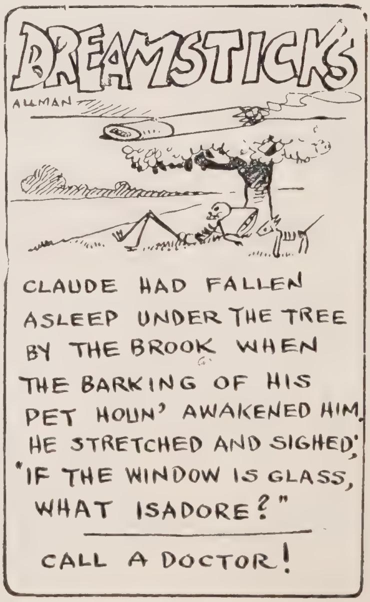
W.H. Kent refers to Rankin and other giving data which shows costs per H.P.H., 3½ to 15c, the later cost being for 8½ft. mills, the size commonly used. Individual plant users in each district are almost invariably the first to sign for Hydro Electric power.

The farmer as a user is usually more liberal in his uses, has a larger installation and more possible uses than urban customers. The appended list of installations, cost of installation, annual uses, annual cost and work done are included as a part of the paper for your use at a reference if interested.

Syndicate have been formed in different parts of the province, whereby a number of farmers form a company to acquire, own and operate a large motor and outfit for doing their heavier work. These have been a success from their point of view, and when operated on a system which is not too small, would be a benefit to the system by reason of the increased uses, if there be a sufficient number served by the syndicate. In this we again come to the principle which must be kept in mind when considering rural services viz:— "Make the maximum use of the service when it is installed, and keep the peak low.—Good load factor."

From the manufacturers and distributors' viewpoint the rural business is no less a problem than from ours. The residents in rural districts from time imemorial have been the butt of the "gold brick saleman". So be careful at the start, and we believe the field now open for business will enlarge greatly. The business is there but the rural resident is rather "gun-shy" of the city and large town salesman; gain their confidence by sensible dealings, "don't advise them to use vacuum cleaners for the cows in cases where the stables need attention." Local men in most cases can secure the business better than outsideers,, and have the advantage of knowing the people, their faults and their virtues.

In conclusion as the preacher says, the slogan "Do it Electrically" can now be applied in the country as well as in town, and the Hydro principle of "Co-operation" should be specially emphasized in approaching and dealing with farmers as a class. The Commission will be pleased if you can help us in getting information to people in your several districts adjacent to the urban municipalities you represent, we for our part will endeavour to supply you from time to time with such information as we can.



TABULATION OF SOME ACTUAL FIGURES ON RURAL SERVICE.

The following series of tables are compiled from data taken in Brock Township, Ontario County, and are for the purpose of illustrating comparatively what can be accomplished in any rural community.

Table Showing Comparative Data on Installation For Rural Electric Service

Farm No.	I	II	III	IV	V	VI	VII	VIII	IX
House Wiring									
No. of Outlets	18	23	21	29	12	41	26	28	20
Cost of Wiring	$100.00	$190.00	$100.00	$115.00	$100.00	$130.00	$ 75.00	$100.00	$ 75.00
Cost of Fixtures	$ 10.00	$ 75.00	$ 80.00	$ 18.00	—	—	—	—	—
Barn Wiring									
No. of Outlets	17	22	16	17	13	20	16	15	11
Motor	1	1	1	1	1	1	1	1	1
Cost of Wiring	$151.50	$150.00	$170.00	$158.73	$138.00	$200.00	$175.00	$166.00	$145.00
Motor Installation									
Sizes in H.P.	5	8	5	5	5	5½	5	5	5½
Cost	$148.50	$378.00	$165.00	$149.50	$176.00	$220.00	$165.00	$155.00	$235.00
Line to Road									
Length in Rods	18	20	255	36	60	24	60	49	24
Poles included	—	—	—	—	—	—	2	—	–
Cost of line	$ 30.00	$ 50.00	$119.34	$ 63.45	$265.00	$ 49.56	$100.07	$ 53.87	$ 54.34
Total Cost	$440.00	$843.00	$634.34	$504.76	$679.00	$599.56	$515.07	$474.87	$509.34

TABLE SHOWING COMPARATIVE OPERATING DATA ON RURAL ELECTRIC SERVICE

Farm No.	I	II	III	IV	V	VI	VII	VIII	IX
Rates									
Annual Service	$60	$60	$36	$36	$60	$60	$60	$60	$36
1st Meter Rate	7c.	7c.	7c.	7c.	7c.	7c.	7c.	7c.	7c.
Annual K.W.H.					¼ yr.				
In lighting	130	946	295	387	88	1138	434	604	276
In power	284	1219	702	347	119	681	398	514	278
Work Done									
Bu. chopping	1000	5000	3000	1500	175	4000	3000	2400	1500
Root pulping	1200	35 Hrs.	—	3000	700	3000	500	3000	4500
Hrs. Milking	90	150	—	—	—	—	—	—	—
Separating	yes	yes	yes	—	—	—	—	—	—
Pumping	yes	yes	—	yes	—	yes	—	175 hrs.	400 hrs.
Feed Cutt'g	—	yes	yes	—	15 hrs.	60 hrs.	30 hrs.	20 hrs.	—
Total Cost	$85.12	$196.10	$95.15	$79.45	$26.48	$151.07	$110.57	$126.49	$73.78

Minutes of Convention

THE Convention was called to order on the afternoon of Thursday January 26th at 2.30 o'clock in room C 26, Chemistry and Mining Building, University of Toronto, by the President, Mr. M. J. McHenry, who gave a short adress outlining the activities of the Association during the past year and welcoming the delegates.

Moved by Mr. E. V. Buchanan, seconded by Mr. H. F. Shearer.

That the minutes of the June Convention at Niagara Falls and of the Executive Committee held on October 21, 1921 be passed as published in the Bulletin.

Carried.

The report of the auditors was read which showed a balance of cash on hand of $789.07.

Moved by Mr. J. E. B. Phelps, seconded by Mr. A. T. Hicks.

That the report of the auditors be adopted.

Carried.

Mr. A. T. Hicks reported progress by the Committee on Accident Prevention and Health Promotion and promised something definite from this Committee in the future.

Mr. R. H. Starr reported on the work done by the Regulations and Standards Committee. Complaints regarding the application of the Rules and Regulations for electric wiring had been taken up with the Chief Electrical Inspector with satisfactory results. The standardization of oils had also been considered and it was recommended that the Association take action towards such standardization.

Moved by Mr. H. F. Shearer, seconded by Mr. P. B. Yates.

That the report of the Regulations and Standards Committee he adopted and that the Executive of the Association be empowered to take up with the Department at Ottawa the question of standardization of transformer oils.

Carried.

A letter from Mr. Geo. O. Phillips, Manager of the Twin City Electrical Exhibition was read. This announced an Electrical Exhibition to be given in Kitchener during the week of May 1st to 6th next and extending a hearty invitation to the Association to attend it.

Mr. V. S. McIntyre then outlined to the Association the nature of the proposed exhibition and as representative from Kitchener added a verbal invitation to all to attend.

By motions duly moved and seconded—Mr. C. A. Moat was nominated Associate, and The Sterling Electric Company, Commercial member of the Association.

Moved by Mr. O. M. Perry, seconded by Mr. H. O. Fisk.

That the Constitution and By-Laws be amended by the insertion of the following:—

CLAUSE 7 (b)—

"The Executive Committee may institute Standing Committees from time to time, and may appoint committee

members to act pro tem until the succeeding annual election."

Former clauses 7 (b), (c), (d) and (e) will be numbered 7 (c), (d), (e) and (f) respectively.

Carried.

Mr. H. F. Shearer referred to the minutes of the June Convention and also to a resolution passed by the Executive Committee at its last meeting in reference to Licensing of Electrical Contractors. He asked that some action be taken by the Association to see that the proposed bill does not go through in its present form.

Moved by Mr. P. B. Yates, seconded by Mr. E. V. Buchanan.

That the Ontario Municipal Electrical Association be asked to deal with the proposed legislation regarding the Licensing of Electrical Contractors.

Carried.

The scrutineers reported that the balloting for officers for 1922 had resulted in the election of the following gentlemen:—

President—M. J. McHenry; Vice-President—A. T. Hicks; Secretary—S. R. A. Clement; Treasurer—G. J. Mickler; Directors at Large: P. B. Yates; O. H. Scott; H. H. Couzens; District Directors: Niagara District, J. J. Heeg; Central District, W. E. Reesor; Georgian Bay District, E. J. Stapleton; Eastern District, H. F. Shearer; Northern District, R. H. Stratford.

Mr. T. C. James, Assistant Engineer, Hydro-Electric Power Commission of Ontario gave a very interesting talk on The Nipigon Development, which was fully illustrated.

Moved by Mr. P. B. Yates, seconded by Mr. R, H, Starr.

That a hearty vote of thanks be extended to Mr. James for his very interesting lecture.

Carried.

The proceedings were adjourned at 5.15 until the next morning.

At 6.00 o'clock the Association met at Binghams for the Convention Dinner. The guest of the evening was Major Hume Cronyn, Chairman, Toronto Railway Arbitration Board who gave a very interesting address.

Friday January 27th, morning session.

Mr. G. F. Drewery, Assistant Engineer, Hydro-Electric Power Commission of Ontario, read a paper entitled "The Effect of Underloaded Transformers on System Power Factor."

Discussion following this paper was by Messrs. E. V. Buchanan, J. Showalter, R. T. Jeffery, C. A. Baker, A. B. Cooper, E. I. Sifton and D. E. Charters.

Moved by Mr. O. M. Perry, seconded by Mr. E. I. Sifton.

That a hearty vote of thanks be extended to Mr. Drewry for his very able paper.

Carried.

Mr. S. L. B. Lines, President, Chamberlain and Hookham Meter Co. Limited, read a paper on "The Measurement of Kilovolt Amperes for Power Billing".

Discussion following this paper was by Messrs, J. E. B. Phelps, T.R.C. Flint, P. M. Lincoln, E. R. Lawler, G. F. Drewry and the President.

Moved by Mr. J. J. Heeg, and duly seconded. That a hearty vote of thanks be extended to Mr. Lines.

Carried.

The proceedings adjourned at 12.30 o'clock P.M. to meet again that afternoon at 2.30 o'clock.

At the afternoon session Mr. J. W. Purcell, Farms Engineer, Hydro-Electric Power Commission read a paper on "Further Developments in Rural Power Distribution." After reading his paper he showed a number of pictures he explained fully. After according a hearty vote of thanks to Mr. Purcell the Convention adjourned.

On that evening the Association became the guests of Zeta Lodge A.F. & A.M. where a very enjoyable time was experienced by all. Sir Adam Beck was the special guest of the Lodge on that occassion and gave a talk that was very much appreciated by everyone.

The register shows the attendance at the Convention to have been 180—made up as follows:—

Class A	56
Class B	14
Commercial	67
Associates	24
Visitors	19

There were 177 at the Convention Dinner.

Toronto, Ont. January 24, 1922.

MR. M. J. MCHENRY,

President, Association of Municipal Electric Utilities of Ontario.

Dear Sir:

We beg to advise that we have audited the accounts of the above Association for the year 1921.

The amounts shown as being received and given on appended statement are certified to by the Secretary as being the total receipts for the year, and all disbursements are supported by properly authorized vouchers. The balance as shown to be on hand is in accordance with the pass book as at January 7, 1922.

STATEMENTS OF RECEIPTS AND DISBURSEMENTS

RECEIPTS:

Balance on hand Jan. 1, 1921	$- 799.35	
Membership fees	1,145.00	
Commercial donations, 45 at $10.00	450.00	
January Convention dinner	252.00	
June Convention dinner	434.00	
Rental from June Exhibit	112.75	
Bank Interest	27.90	
		$3,221.00

DISBURSEMENTS:

Printing and Postage	$ 578.44
January Convention dinner	272.00
June Convention dinner	717.00

June Convention expenses	212.04	
Reporting	179.50	
Special cars	102.50	
Secretary	75.00	
Enteraining	31.00	
Rent of Buildings	10.00	
Travelling expenses	238.25	
Express and Exchange	16.20	
	2,431.93	
Balance in Bank	789.07	
		$3,221.00

Respectfully submitted,
W. G. PIERDON,
H. P. L. HILLMAN,
Auditors.

January 7, 1922.

MEMORANDUM TO THE AUDITORS:

I give in the following a detailed statement covering all monies received by me and handed to the Treasurer during the year 1921. Statement is as follows:

34 Utilities at $2.00	68.00
33 Utilities at 5.00	165.00
30 Utilities at 7.50	150.00
16 Utilities at 10.00	160.00
6 Utilities at 15.00	90.00
11 Utilities at 25.00	275.00
1 Utilities at 35.00	35.00
4 Utilities at 50.00	200.00
1 Utility at 2.00 (Credit to 1922)	2.00
45 Commercial at 10.00	450.00
Convention January 1921. 168 dinner tickets at $1.50	252.00
Convention June 23rd, 1921, 217 dinner tickets at $2.00	434.00
Rental from Exhibit	112.75
Total Receipts	$2,393.75

Yours truly,
(Sgd.) S. R. A. CLEMENT,
Secretary.

I certify that the foregoing is a true statement of all receipts of the Association during the year 1921.

(Sgd.) S. R. A. Clement.

Inspection of Structural Steel

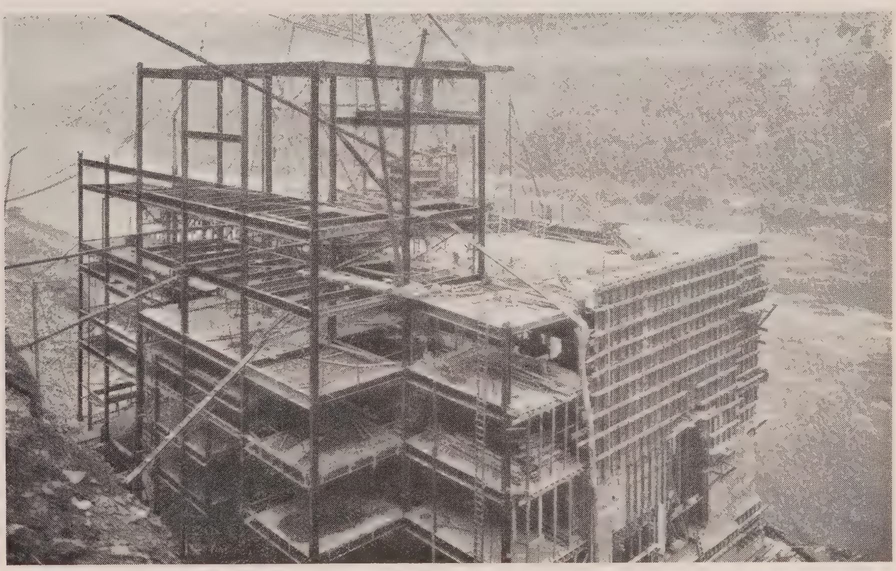
INSPECTION as ordinarily provided for in specifications is a form of insurance. Its object is to insure the performance of the specifications in all details so that the purchaser will receive that which the manufacturer contracted to deliver.

The inspection of structural steel with which this article is specially concerned may be classified into the inspection of:—

(a) Materials;
(b) Workmanship;
(c) Dimensions;
(d) Erection;

Inspection of Materials

Inspection of materials covers all the processes of manufacture as well as inspection of the finished product. In all but exceptional cases it is sufficient in the inspection of steel for structural purposes to confine the inspection of the material to an examination of the finished product. This includes testing samples of the steel to determine if the chemical and physical properties are correct. In the surface examination of the steel defects such as slivers, cracks and blisters are noted and where they are of a serious nature, they are cause for the rejection of the pieces in which they occur.



Erection of Power House Superstructure, Queenston-Chippawa Power Development, July 22, 1921.

Stoney Control Gate (raised), Queenston-Chippawa Power Development.

Rusted surfaces are also examined and the inspector has to distinguish between surface rust, which can be removed with a wire brush, and pitting which is more serious, and which is usually a cause for discarding the material.

INSPECTION OF WORKMANSHIP

Under this heading come the various operations carried out in the shop, the most important of which are shearing, punching, reaming, fitting and rivetting. It is the duty of the inspector to see that these are properly

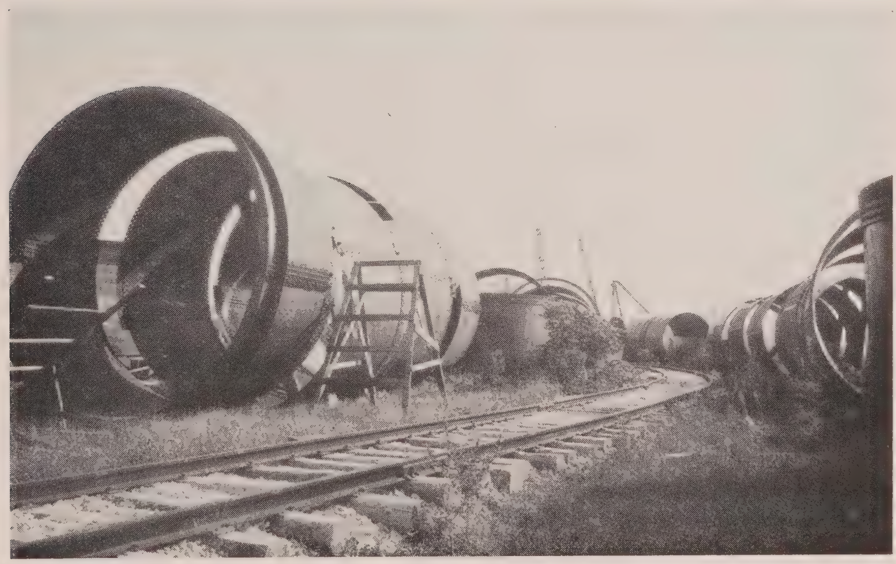
carried out without damage to the steel and in accordance with the specifications.

There are some points about which the inspector has to be particularly alert. In shearing care should be taken to see that the distance from the centre of rivet holes to the edge of the plate is not less than the minimum distance required by the specifications. In punching, the centering of rivet holes should be watched. In reaming care should be taken to see that the drills are inserted at right angles to the axis of the member being drilled. In fitting all burrs should be removed from the edge of rivet holes and the pieces drawn together and bolted tightly with sufficient bolts to keep them in close contact while they are being rivetted.

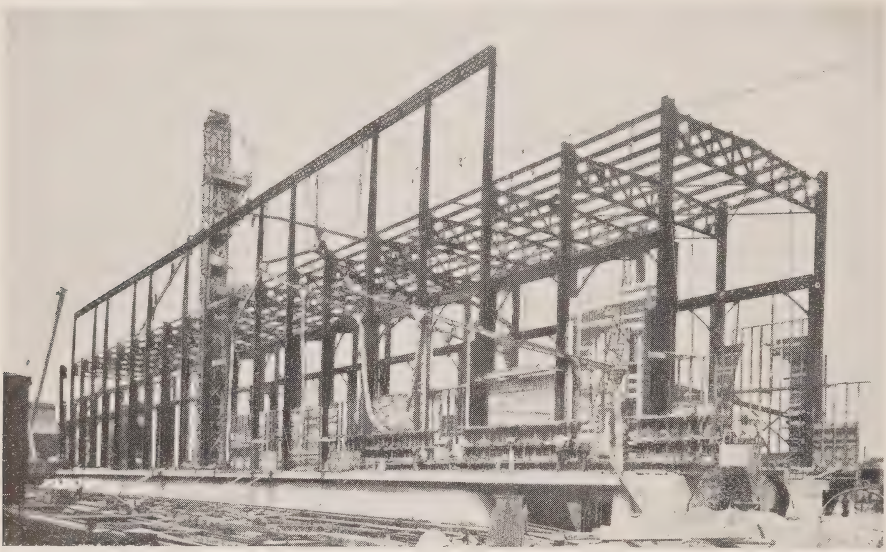
Careful attention should be given to the matching of the holes when two or more pieces are to be rivetted together. If the matching of the holes is not good, it may be corrected, where the conditions will allow, by reaming the holes to a larger diameter and using a rivet of corresponding size.

In rivetting the inspector must see that the rivets are tight and have properly formed concentric heads. Strict attention should be given to the dies and all worn dies should be discarded. Close watch should be kept on the compressor gauge to see that sufficient pressure is being supplied to the rivetting machines.

There are other operations perhaps not quite so important as those we have already mentioned to which at-



Sixteen-foot Rings for Penstocks in Storage Yard.



Erection of Screen House Superstructure, Queenston-Chippawa Power Development.

tention must be given. Among them are chipping, countersinking, grinding and milling.

Dimensions

The inspector is not only responsible for workmanship but it is his duty to see that the fabricated pieces conform to the drawings in every detail. The sizes of the sections composing the member, the overall length, the spacing of the rivets and other dimensions have to be checked up. Particular attention is paid to the open holes for field connections and to all governing dimensions such as the height of brackets on columns and the distance from the end of a beam to the point where other beams frame in. In structural steel designing certain combinations of members occur frequently and the designs of these are usually standardized. These standards are different for each shop and thus it becomes necessary for an inspector to familiarize himself with the practice of each shop. These standards are usually available in blue print form from the drawing office.

Erection

The field inspector takes the fabricated steel and sees that it is erected to form the structure desired. Inspection of the assembly of the parts and the rivetting, painting and other operations are part of his duties.

General Duties

The inspector has other duties arising directly out of his position as representative of the purchaser. He is usually required to follow the progress of the work and to assist in getting the different parts of the work in the order required in the field. He

Strauss Bascule Highway Span at Chippawa. Approximate Overall Length, 250 Feet.

has also to keep track of all extras on the contract and to check the weight of all fabricated material purchased on a pound price basis. He has also to make progress reports on the job from week to week to his principals.

The Commission maintains an inspection staff in the laboratories department which is charged with the duty of inspection as outlined above During last year this department inspected upwards of 11,000 tons of structural steel made up into buildings, bridges, transmission towers, penstocks and tanks. The accompanying illustrations show some of the more important types of this work.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES

Minutes of Meeting of Executive Committee held in Room 312, Administration Building, Hydro-Electric Power Commission of Ontario, on February 28th, 1922.

The meeting was called to order at 10.00 o'clock a.m. by Mr. M. J. McHenry, President.

Other members of the Executive present were—Messrs. A. T. Hicks; O. H. Scott; E. J. Stapleton; H. F. Shearer; R. H. Staford; J. J. Heeg; G. J. Mickler and S. R. A. Clement, Secretary.

Resolutions appointing members of Standing Committees of the Association for the year 1922, were presented.

Moved by Mr. A. T. Hicks, seconded by Mr. H. F. Shearer.

That the Papers Committee consist

of Messrs. O. H. Scott, Chairman; A. B. Cooper; R. T. Jeffery; L. G. Ireland and O. M. Perry.

Carried.

Moved by Mr. H. F. Shearer, seconded by Mr. E. J. Stapleton.

That the Convention Committee consist of Messrs. P. B. Yates, Chairman; C. H. Hopper; J. J. Jeffery; J. E. B. Phelps; W. E. Reesor and another member to be chosen after decision has been made of the location of the summer convention.

Carried.

Moved by Mr. O. H. Scott, seconded by Mr. A. T. Hicks.

That the Regulations and Standards Committee consist of Messrs. J. J. Heeg, Chairman; E. J. Stapleton; R. H. Starr; J. E. Brown; W. P. Dobson and A. G. Hall.

Carried.

Moved by Mr. O. H. Scott, seconded by Mr. H. F. Shearer.

That the Committee on Accident Prevention and Health Promotion consist of Messrs. A. T. Hicks, Chairman W. R. Catton; E. M. Ashworth; T. C. James; Wills Maclachlan and S. R. A. Clement.

Carried.

Moved by Mr. H. F. Shearer, seconded by Mr. O. H. Scott.

That Messrs. W. G. Pierdon and H. P. L. Hillman be nominated auditors.

Carried.

Moved by Mr. E. J. Stapleton, seconded by Mr. A. T. Hicks.

That the Merchandising Committee as it now exists be continued for the present year.

Carried.

The Merchandising Committee consists of Messrs. M. J. McHenry, Chairman; O. M. Perry; E. V. Buchanan; P. B. Yates; E. I. Sifton; O. H. Scott; V. S. McIntyre; E. M. Ashworth; J. E. B. Phelps; J. J. Heeg; S. J. Millikin and H. F. Shearer.

Mr. O. H. Scott reported on the meeting held in Montreal on February 6th, for the purpose of organizing a Canadian Electrical Council. At that meeting the following resolution was agreed to unanimously.

"That an advisory body be formed, to be known as the Canadian Electrical Council, to be composed of four representatives each from the Canadian Electrical Association, the Association of Municipal Electrical Utilities and the Canadian Electrical Supply Manufacturers' Association. In the meantime the duty of this Council shall be to receive or initiate suggestions, and make recommendations thereon, regarding the closer co-operation of the different elements in the industry, i.e., the Council shall be, in a sense, a clearing house for suggestions regarding co-operation among its three constituent members. A sub-committee is to be appointed by the Council that will deal more particularly with questions of common interest between the C.E.-A. and the A.M.E.U., and a second sub-committee, also appointed by the Council, will give its attention to the merchandising phase of the industry with a view to better and more general organization."

Moved by Mr. A. T. Hicks, seconded by Mr. J. J. Heeg.

That the report on the Canadian Electrical Council be adopted and that

Messrs. M. J. McHenry, P.B. Yates; O. H. Scott and E. V. Buchanan be appointed a committee to represent this Association on it.

Carried.

At the Convention of the Association held at Toronto on January 26th and 27th, the following resolution was passed:—

" that the Executive of the Association be empowered to take up with the Department at Ottawa the question of standardization of transformer oils."

Moved by Mr. H. F. Shearer, seconded by Mr. O. H. Scott.

That the question of standardization of transformer oils be referred to the Canadian Electrical Council and that further action be taken by that Council. *Carried.*

Mr. O. H. Scott reported as to the results of the efforts to have the Department of Trade and Commerce at Ottawa extend the seal period on electrical meters from five to ten years. It was shown that there must be further action by the Utilities and further information collected before the results desired can be obtained. The president also presented the following letter from Mr. P. T. Davies, Chairman, Canadian Electrical Association on Meter Seal Extension.

Feb. 8th 1922.

"Mr. M. J. McHenry,

President, Association of Municipal Electrical Utilities of Ontario.
Box 330, Walkerville, Ontario.

Dear Mr. McHenry:—

I attach you herewith, copy of letter covering work ahead of us on the Meter Seal Extension. As soon as possible I will get the wheels working and put you in touch with whoever is carrying out the work in our Association.

Yours very truly,

(Sgd.) P. T. DAVIES,
Chairman, C.E.A. Committee on Meter Seal Extension."

Feb. 8th 1922

"Mr. Eug. Vinet,

Secretary, Canadian Electrical Association.

The Shawinigan Water & Power Co., Power Bldg.,
83 Craig St. West, Montreal.

Dear Mr. Vinet:—

Re: Meter Seal Extension

I beg to report that our Committee waited on the Minister at Ottawa yesterday and presented the Memorial.

The Minister admitted that he was impressed with our side of the story and after stating that they were not going to introduce any new legislation at the coming session, promised to treat the matter fairly and take action at a later session, if he found it desirable.

Mr. Higman was present, and brought up objections which we must combat; first of these was, that it was the practice in the United States to test single phase two wire small meters every four years at least; he stated that the N.E.L.A. recommended this practice of meter handling, he also stated that the New York Edison Company, for their own protection, tested them every 36 months, and the Rochester Railway, Light and Power Company, every four years; he also took

exception to our average figure of 96% of meters being accurate after five years and introduced a few statistics from small isolated towns, to show that the average figure for accurate meters was 70%, and that 30% were rejected. We must therefore develop immediately, statistics to furnish Mr. Higman with a copy for the Minister covering our tests on all meters which are brought in month by month.

I would like to know whether this work will be a function of this Committee or whether it shall be carried on by the Meter Committee? It seems to me that the Meter Committee should get out a form and have returns sent in from all our larger Companies at least, showing the accuracy of time expired meters as brought in from time to time; these reports should be sent to this Committee once a month when a summation figure should be made by them and sent on to the Department. Secondly, we must get in touch with the N.E.L.A. Meter Committee and also the Companies mentioned, which by the way included the Central Illinois System, who have a ruling that meters are to be tested I think every 36 months; find out from them whether this testing is a survival of an old practice or made necessary by Commission rulings, and also what their ideas are as to the accuracy of small single phase meters on household premises after periods of 5, 8, or 10 years?

I think it may very well be found that a lot of the testing they had done was a waste of time and they would be of the same opinion as we are, and satisfied to leave the meters out without testing for longer periods than the Commission regulation. This work of investigating Mr. Higman's claims should also I believe be carried on by the Meter Committee. You might take this matter up with Mr. Smith and Mr. Holder, with a view to determining who shall carry out the work.

Mr. McHenry advises us that we could line up the Municipal system to send in this information regularly each month, and it would be necessary for us to advise them and collaborate getting out one form which will be suitable for both Associations and in this way be capable of monthly summation.

Yours very truly,

(SGD.) P. T. D.,

"CHAIRMAN, C.E.A. COMMITTEE METER SEAL EXTENSION'

Moved by Mr. O. H. Scott, seconded by Mr. A. T. Hicks.

That a letter be sent to the larger Utilities asking them to co-operate with the Canadian Electrical Association in getting information re re-testing of meters, and that Messrs. R. T. Jeffery and L. G. Ireland take this matter up with the smaller Utilities.

Carried.

Moved by Mr. R. H. Staford, seconded by Mr. J. J. Heeg.

That the following be elected Associates of this Association.

Messrs. R. M. Saxby, A. D. Brunskill, A. C. McBride, A. J. Wright, R. E. Jones, E. P. Chamberlain, E. F. Hinch, J. R. Smith.

Carried.

Moved by Mr. O. H. Scott, seconded by Mr. E. J. Stapleton.

That an honoranium be granted the Secretary of the same amount as granted last year.

Carried.

Moved by Mr. O. H. Scott, seconded by Mr. E. J. Stapleton.

That a budget committee be formed consisting of the President, Secretary and Treasurer to bring down a report to the next Executive meeting, and that in the meantime the travelling expenses of the committee members be paid as now provided in the By-Laws.

Carried.

Mr. A. T. Hicks, Chairman, Committee on Accident Prevention and Health Promotion, presented a resolution for consideration by the Executive. After considering the same it was—

Moved by Mr. P. B. Yates, seconded by Mr. H. F. Shearer.

"That the Association recommend that the Commission institute a periodic inspection of distribution systems, especially in smaller Municipalities and that the results of such inspections be made available to this Committee for study."

Carried.

The meeting then adjourned at 12.15 o'clock P.M.

PERSONAL CONTACT WITH CUSTOMERS REDUCES COMPLAINTS OF HIGH BILLS.

By using the slip shown here the Virginia Railway & Power Company, Richmond, Va., has almost eliminated complaints of high bills and added a closer personal touch to its service.

"It is virtually impossible to establish a personal contact with customers," says John E. Harvell, General Manager, "unless something occurs out of the usual routine. We have found one of the chief causes of complaint to be from errors in meter reading. Our method of handling this problem is as follows:—

"Each meter reader is required, after reading a customer's meter, to subtract the figures of the previous reading before leaving the customer's premises. On any reading showing 50 per cent increase or decrease in consumption, if the previous consumption was 50 kw.-hr. or more, the meter must again be read as a check.

"Readings which show a 50 per cent difference in consumption are turned in to the installation department for investigation. An Inspector is sent out to ascertain, if possible, the reason for the increase or decrease. He first informs the customer of the readings, showing the consumption, and asks if he can account for the difference. Approximately one-half of the customers can name the cause, and thus many complaints are forestalled. In the event that the customer does not know the cause, the Inspector makes a test of the installation to locate any ground or other trouble, and if anything is found the Customer is informed just how to have it corrected.

"Whenever these investigations are made the auditing department turns the bill over to the commercial department for handling. This department then delivers the bill to the customer

with the notice calling his attention to the investigation. Under this system we have been able to reduce our high-bill complaints 95 per cent."

ATTENTION

In connection with the attached bill, your attention is called to the considerable increase in consumption over the preceding meter period. To be certain that the readings on billing as rendered were correct, special investigation was made (Nov. 14, 1921), which verifies figures as turned in by meter reader.

If you are not able to trace the cause of increase, we will be very glad, on your advice, to further assist in this connection.

You will oblige us by directing your request to the Commercial Department

Yours very truly,

G. H. SMITH,
Commercial Manager.

NOTICE ATTACHED TO BILLS SHOWING UNUSUALLY HIGH CONSUMPTION

IT IS THE SMALL COURTESIES THAT COUNT WITH MOST PEOPLE

At the entrance to the office of the Minneapolis General Electric Company, an attractive and tactful young lady is stationed whose business it is to greet with a smile all who come in and to volunteer assistance and information. She knows regular customers by name and to them she typifies a desire to serve when the traveler steps of the Kansas City Union Station, a sign so placed that it is impossible to miss it, tells him the facts he wants to know regarding street-railway fares. Across the viaduct and a few blocks up town in the direction in which the stranger is most likely to go, is a little information booth at which a street-railway employee cheerfully gives the information that is needed to get around the city without loss of time.

These are litle things, but they are the finest and easiest of avenues to pleasant public relations. The average individual dislikes to go into an establishment and wander around trying to discover where he can be quickly served or obtain the information he may be seeking. If he has, added to this, the feeling created by the familiar 'wotinell' attitude so many persons delight in assuming toward an inquirer, he is quite likely to go away with an unfavorable impression of those with whom he has been forced to transact his business.

ELECTRICAL WORLD.

NOTICE

TO ELECTRICAL MANUFACTURERS, JOBBERS AND DEALERS

Electrical material, devices and fittings for use on inside electrical installations in the Province of Ontario, *must not be offered for sale* until their design and construction has been approved by the Hydro-Electric Power Commission of Ontario. (6 Geo. V., Chapter 19, 1916)

Manufacturers whose products are approved and listed by other recognized authorities, and which also meet the requirements of this Commission, may have same placed on the approval list by making application in accordance with Approval Laboratories' Bulletin No. 5, a copy of which will be sent upon request.

ONTARIO DEALERS' ATTENTION IS CALLED TO THE FOREGOING REGULATION—WHICH PROHIBITS THE SALE OF UNAPPROVED ELECTRICAL DEVICES.

APPROVAL LABORATORIES

HYDRO-ELECTRIC POWER COMMISSION
OF ONTARIO

8 STRACHAN AVENUE, TORONTO, ONTARIO

CONTENTS

VOL. IX. NO. 3

MARCH-APRIL, 1922

Summary of Reply to Murray-Flood Report

Criticising the Operation of the Hydro-Electric Power Commission of Ontario

IN this summary will be found replies to the main criticisms of the operations of the Hydro-Electric Power Commission of Ontario, made in the Murray-Flood report. It is believed that to the reader who is already familiar with all the facts, this summary will be convincing and will completely refute the criticisms and charges made by Mr. Murray. Those not familiar with all the details of the Commission's structure and operations are referred to the main body of this publication, in which will be found supporting data sufficient to establish fully the fact that the structure of the Hydro-Electric Power Commission is sound and that its operations have attained a very high degree of success.

A. 1. Ontario is the workshop of the Dominion of Canada. The one great resource which it lacks is a supply of coal. This, however, is more than compensated for by the bountiful supply of water powers conveniently located with respect to the large commercial centres.

2. Prior to 1900 the power developed from these water powers was available for use by such small industries as could be located immediately adjoining these water powers, but about this time the long distance transmission of electric power became a commercial possibility.

3. It remained for the people of the Province to decide how this supply of power was to be distributed. Before deciding on a definite plan, the system adopted by practically all of the States in the United States was given careful consideration. This plan whereby the power is distributed by private companies at rates controlled by Public Service Commission has its advantages and also its disadvantages, but the people of the Province of Ontario decided on an entirely new method of operation and control under independent commission control and in 1907, public sentiment was finally crystallized in the Provincial Legislature in the Power Commission Act. Since that time the operations of the Commission have been conducted in accordance with the provisions of this Act and amendments thereto.

4. The success of the plan adopted by the Municipalities of the Province is clearly evidenced by the growth of the enterprise since the date of its inception. From 12 municipalities supplied from one system in 1910 with a load of less than 1,000 h.p. and a capital investment of approximately $3,750,000, the project has grown steadily until at the present time there are over 350 Municipalities supplied from 14 different systems with a total capital expenditure of approximately $200,000,000. The amount of power supplied to these Municipalities now exceeds 350,000 h.p., and the Com-

mission has in the course of construction additional power plants which when completed will give a total generating capacity under the control and operation of the Commission of approximately 1,000,000 h.p.

5. From its inception the Commission has been subject to the most bitter and relentless criticism and its opponents have spared neither time, money nor effort to hamper the development of the scheme at every opportunity. The first written criticism financed by the private power interests was a book entitled "An Expensive Experiment." This book predicted that credit would be destroyed, confidence in public institutions would be wiped out, financial ruin was to face the people, an enormous burden of taxation would be imposed in every Muncipality, and in fact, the general financial structure of the Province of Ontario would be left a devastated ruin. When the actual results of the operation of the Co-operative Municipal Ownership plan are compared with these inspired prophecies, the result can only be to completely discount the prophetic abilities of those who sponsored the publication of this fatuous book. The last published criticism of this nature is the Murray-Flood report financed by the National Electric Light Association, an organization of American private electric companies, and compiled by W. S. Murray for the express purpose of discrediting the entire Hydro-Electric scheme in the eyes of the American and Canadian people. The purpose of this report is exactly the same as that of the earlier publication we have just referred to, and judging from the successful outcome of over 10 years' experience in the Province of Ontario, the people of this Province are thoroughly justified in anticipating the same ignominious and inglorious demise as was reached by the "Expensive Experiment."

B. 1. Throughout the report Mr. Murray consistently and designedly uses the expression "Governmental Ownership" as applied to the Hydro-Electric systems of this Province. The Hydro-Electric Power enterprise of the Province of Ontario, cannot be classed as "Governmental Ownership" in any sense of the term. The entire plan is one of a partnership of Municipalities under which each partner obtains its required supply of electric power at actual cost through the agency of a Commission which functions solely as a trustee for the partnership Municipalities.

2. The Commission in its position as trustee is removed from political control, and under the provisions of the Power Commission Act is given full control of its operations free from politician interference.

3. On page 6 of the Murray report, it is stated:

> "Governmental ownership eliminates, all incentive for gain and throttles initiative. This is evidenced by the far greater growth of privately owned utilities."

This statement may possibly be correct in many cases of Governmental Ownership, but the Hydro-Electric enterprise in the Province of Ontario is not operated under Governmental

Ownership, but is *co-operative municipal ownership under independent commission control,* which in no way resembles Governmental Ownership. The steady and phenomenal growth of the undertaking since its inception and the consistent reduction of rates at which electric energy is supplied in the Municipalities which are partners in the enterprise, clearly shows the unprejudiced observer that initiative is not being throttled, but that on the contrary, initiative, organizing and operating ability of a very high order have formed an integral part of the development and expansion of the undertaking.

4. The results of the Commission's operations as published annually are the very best evidence that could be offered that the financial frame work or Ontario's Co-operative Municipal Electric Utility has been most carefully planned and soundly constructed and that the enterprise has been faithfully and honestly administered. The most searching and rigid audit has been and is carried on continuously, and the reports of the auditors from year to year have failed to disclose anything which does not reflect credit upon the Commission, or to furnish to the partner Municipalities anything which might cause them to lose confidence in any degree in the soundness of the enterprise in the manner in which it is operated.

5. Our opponents state that the Commission is a monopoly, and it is frankly admitted that it is desired to create a monopoly in the Province of Ontario in the ownership and operation of electric public utility sytems, for duplication of transmission lines and distributing by competing companies not only tends to inefficient operation, but increases the cost of service to the consumer who must be compelled to pay for two systems instead of one where no competition exists. In many cases the Commission has purchased the plants of private companies, one of these being the Ontario Power Company, whose plant is located at Niagara Falls, and Mr. Murray states that in the operation of this Company the Commission is violating the basic principles on which we claim to operate, in that, the Commission does not set aside a sinking fund to retire the bonds issued to pay for the assets of this Company as required by the Power Commission Act. Mr. Murray makes this statement in spite of the fact that for the year 1921, the Commission set aside an amount of $382,270,000 out of the yearly revenue as a sinking fund to retire these bonds.

6. Mr. Murray has made an effort to convince his readers that the Commission is an autocratic body clothed with powers of extreme breadth, and with the authority to apply these powers without fear of check or control through the courts of the Province. Statements which Mr. Murray has made in this respect are totally untrue, the best evidence of which will be found further on in this publication, where it is shown that in his efforts to establish his case he has deliberately misquoted the Power Commision Act. The only particular in which the Commission is not subject to the jurisdiction of the courts is in the fixing of rates, and in matters dealing with

the inspection and regulation of electric works with regard to public safety. A very astonishing statement made by Mr. Murray is found on Page 10 of his report.

> "No suit could have been brought since the Commission cannot be sued without a fiat from the Attorney-General, and to date no fiat has been granted."

This statement is absolutely false, and the fact is that in the period of 1912-1921, 29 fiats were granted by the Attorney-General to permit legal action to be brought against the Commission.

7. Mr. Murray accuses the Commission of dealing autocratically with private interests, and of abusing its powers of expropriation in dealing with private companies. This statement, however, is not borne out by the facts. Since commencing operations, the Commission, as trustee for the municipalities, has purchased no less than 20 water powers, 30 hydraulic generating plants, and over 60 electric distributing systems, and in no single instance has the Commission exercised its powers of expropriation.

8. On page 10 of his report, Mr. Murray states that the municipalities are subject to coercion by the Commission, in the operation of their local electric utilities, and attempts to give his readers of the report the impression that the Commission has the authority to force a municipality to assume the liability for the plant constructed within its limits to supply power to an individual or corporation. The truth of the matter is, that before any municipality can enter into a contract with the Commission to become a partner in the Co-operative Municipal Ownership plan, the matter must be submitted to a vote of the ratepayers of the municipality.

9. Mr. Murray contends that the principle of service at cost is not sound, and clearly believes that rates should be determined rather on the basis of expediency. The municipalities of this Province are not at all in accord with Mr. Murray's views in this respect, and are convinced that the supply of service at actual cost is the greatest safeguard which they could have against any unfair or discriminatory process in fixing rates. In determining rates at which service can be supplied to the various municipalities, the trustee Commission takes into account all factors entering into the cost of operation on definite and clearly understood principles, which results in each municipality paying its full and proper share, no more and no less. It should also be noted that the principles upon which rates are determined, and the annual adjustment of costs are subject to the scrutiny and approval of the auditors appointed by the Province, and no charge could be made against any municipality without the approval of these auditors. Mr. Murray clearly feels that the application of rates based on the actual cost must result in concentration of industries in municipalities close to the source of power, evidently ignoring a fact that should be self-evident, viz.: that the cost of power is only one of a large number of factors governing the decision of manufacturers as to their points of location. Those familiar with the

municipalities in the Province of Ontario which are partners in the Co-operative Municipal enterprise, know without further argument that Mr. Murray's contention is entirely fallacious, and that no such concentration of industries close to the source of power, as he fears, has resulted or is likely to result from the broad based and soundly constructed rate structure of this enterprise.

10. Mr. Murray takes considerable pains to prove that the cost of power supplied in Montreal and Buffalo by private companies is lower than the cost in Toronto as supplied by the Hydro-Electric Power Commission, and to prove his point, Mr. Murray takes the total revenue of the power companies in each city and divides this figure by the total number of kilowatt hours generated. This latter figure, of course, includes all of the power supplied to a number of electro-chemical companies at exceedingly low rates, many of which companies have a directorate interlocking with that of the power company. The true comparison between the rates for service in the cities of Toronto, Montreal, Buffalo and Detroit can only be made by comparing consumers' bills based on the published rates at which current is supplied in these cities. This comparison is clearly set out in this report on pages ...., and clearly demonstrates that the rates for service in Toronto are lower by an exceedingly wide margin than the rates in any of the other cities with which comparison is made.

11. Mr. Murray sets up a remarkable comparison of the cost of street lighting in Toronto and Buffalo, and establishes to his own satisfaction that in 1920 the street lighting cost per capita in Toronto was 67c., as compared with 60c. in Buffalo. Mr. Murray's figures would be quite convincing were it not for the fact that, inadvertently or otherwise, he has omitted to state that in Buffalo more than one-half of the total number of street lights are gas or gasoline lamps, whereas in Toronto there are no street lights other than electric. This means that Mr. Murray has included less than one-half of the total cost of street lighting in Buffalo, and compared it with the cost of all the street lighting in Toronto. So that the reader may thoroughly understand the grossly inaccurate data given as authoritative by Mr. Murray, it is especially requested that the detailed figures given further on in this publication be studied. The net results of the correct comparison show that in 1920 the total cost of street lighting per capita in Buffalo was $1.13, whereas in Toronto it was 64.2c.

12. Mr. Murray goes to considerable pains in his report to show that the Hydro System pays no taxes, and that part of the necessary revenue for the operation of the System is collected through taxes of the municipalities. The truth of the matter is that the Hydro Commission and the Hydro-Electric Systems in the various municipalities are subject to taxation on all lands which they occupy, and *there has never been a single cent collected in the taxes of any municipality to be used in connection with the operation of any Hydro-Electric Utility.*

13. Urgent demands for power for the manuacture of war munitions during the war necessitated proceeding with the Queenston-Chippawa Development. This plant was constructed during a period of maximum cost of labor and material, which increased the cost of the development at least $30,000,000 above the figure at which the plant could have been constructed during normal times. In spite of this fact, it is certain that power can be delivered from this development to the Niagara System and distributed to the consumers in the various municipalities on the System at very little, if any, increase in the rates charged for service previous to the construction of this development. Full details in connection with the cost of construction of this plant are clearly set out in this report on page —.

14. At the urgent and insistent requests of the Municipality of Port Arthur and of the Government of the Province of Ontario, the Commission constructed a development on the Nipigon River to supply power to the Fort William and Port Arthur district. This development was put into commercial operation in December, 1920. Mr. Murray states that the power supply for the district is over developed, and that sufficient power could have been obtained for the district by the extension of the Commission's contract with the Kaministiquia Power Company. Mr. Murray made this statement without true knowledge of the facts, for although the Kaministiquia Power Company is not now supplying the Commission with power for Port Arthur, all of its available capacity is now being used to supply other customers, and it is expected that within the year at least 50% of the Nipigon plant will be in active operation. It is anticipated that the large pulp and paper industries and elevator loads in the district will rapidly utilize the balance of the available capacity of this plant.

15. In his report, Mr. Murray compares the power supplied to the agricultural industry in the Province of Ontario and in the State of California, but does not point out in his report, however, that these figures are non-comparable on account of the difference in the nature of the agricultural industry in these two countries. In the Province of Ontario, the Commission is supplying power to farmers for domestic uses only, such as lighting their houses and barns, operating milking machines, filling silos and other like uses, requiring in all on the average not more than 3 H.P. each, the precipitation in Ontario being sufficient to bring all crops to maturity without irrigation. In California, where there are some 1,470,000 acres of land irrigated by pumping, 297 k.w. hours per acre per annum is required for irrigation purposes, and a total of over 500,000 H.P. is used for irrigation work in this State. These figures show clearly that the power requirements of the agricultural industry in California cannot be compared with those of Ontario.

"Family Spirit" In the Public Utility

By H. A. LEMMON
Stone and Webster, Incorporated, Boston

These pungent thoughts from Mr. Lemmon on the subject of the spirit within the organization of a utility company follow quite naturally his previous article which discussed the relationship between the public service company and the people. It was entitled "What the New Customer Thinks on the First Day," and because it painted a very human picture in a very human way of the costliness of bad first impressions, it has occasioned much interested comment. This paper must not be taken as a general indictment of group insurance, but rather of the halting spirit and foreshortened vision which are content with nothing more than an artificial and impersonal relationship between the company and its employees and then wonder why the kind of loyality and service thus begotten has little heart in it. Group insurance where it is but one feature of an organized family relationship in which the bonds of interest, mutual service and interdependence are forged of human feelings, is something else. In a word, Mr. Lemmon's thought is that no family can do its best if it is unhappy and he shows that happiness among the members of a "utility household" must be builded of those selfsame human factors that make happiness within a home.

I am going to speak very frankly to the readers of the Electrical World about the importance of "family spirit," or better still, "gang spirit" within the company. Before our public utilities can even hope to take their proper places as givers of real service and earners of fair return, they must be imbued with this most powerful incentive to play their part after the fashion of man to man and with the minimum of mechanism designed to better human relations. The first organization and the only one which has survived throughout the ages was invented by nature—we call it the family—and no genius or industry of man directed against it, has ever been able to break it down. Therefore, it must be a safe organization to accept as a model, and when we do that we can hardly be accused of yielding to a passing fad.

Why don't we get this spirit in so many of our modern utilities? We fail to do so simply because we don't really desire it hard enough. Yet the office force cannot handle the public intelligently unless its members know their work, and they cannot know their work if the manager runs his business like a secret society of which he is the sole member. Information

Electrical World, April, 1922.

within the family circle is the first step toward public relations.

"Public Relations." They're all doing it. The shelves are fairly loaded with volumes prepared willingly and anxiously to instruct harassed corporation managers how to attain good public relations. The magazines are full of suggested methods and experience, and if only you will send $6 and get Professor Splifkins' book on "The Unit in Industry" and follow its precepts, your employees will immediately begin sitting up nights knitting "God Bless Our Home" mottoes for your office. I will not attempt to describe Professor Splifkins nor relate the sum of this actual experience with the problem he handles so learnedly. If the reader, who is a manager, lacked imagination, he would not be holding his present post.

WHEN DID GROUP INSURANCE EVER REDUCE LABOUR TURNOVER?

I have had the pleasure of discussing the subject of family spirit with some of the distinguished gentlemen who are engaged in this work for a number of great industrial organizations. Of course they have group insurance, which bids fair to become very popular during the next few years. Group insurance is a wonderful thing. All the employees are bunched and for approximately $10 a head each will receive a beautifully lithographed certificate of policy from the Panacea Insurance Company entitling a man's widow to $1,000 if he dies on her hands during the ensuing year. Life Insurance is a splendid thing, no doubt of it, but the beauty of group insurance is that you do not have to die to begin receiving benefits. For while you are still alive that insurance company will, from time to time, send you little pamphlets such as "How to Keep the Baby Well," "Infantile Paralysis is Dangerous," "All About Milk," "Health and Happiness in the Home," and so on; and if the group is large enough, it may occasionally include medical examinations and free advice.

The insurance companies are a unit in their declaration that group insurance will help all domestic troubles and will reduce the labor turnover—magic phrase. I know of no statistics which show how much group insurance has reduced the labor turnover in any plant, nor of any actual proof that it has reduced it at all. Nor do I know of any instance where the employees indicated that they even wanted group insurance. They never do if they have to pay any portion of the premium. The man who wants life insurance is the old employee with a family and other needy responsibilities. There is not a bit of danger that he will ever leave your employ voluntarily, and the young man whom you would like to nail down to your own particular service does not care a snap whether you give him life insurance or not.

YOU CANNOT BUY LOYALTY

Just as soon as all companies in your field have adopted group insurance it can yield no particular advantage to any of them. To carry out this paternal effort to purchase loyalty, you, Mr. Manager, will have to add

accident and health insurance and thus set a pace which all of your rivals must follow. When they catch up with you in this it will be time to incorporate an old-age pension scheme and see that the race will go on progressing and no final goal be reached.

A lot of companies have officials whose sole job is to bring about the family relationship in corporate organizations These men are called "Industrial relations managers." Is that not a title to cover a department which presumably is trying to make an organization human? What a wonderful thing it would be if a manager could set up a machine in his office, and whenever he felt the need of injecting some real, garden variety of human spirit into his organization, drop a ten-dollar bill or a thousand dollar check into it and accomplish the desired result. Yet the insurance company and the industrial relations managers are attempting to perform just the functions of that machine and in virtually the same manner. The "automat" doesn't seem to have displaced the personal service restaurant—yet.

If I were a manager with a free rein, I would not under any circumstances permit an insurance company or a nickel-in-the-slot machine to get in between any of my men and myself. I would never promise any of them to endeavour to compensate their widows. But a few days after Jim Smith's funeral, I would drop in upon Mrs. Jim Smith—and it would not be the first time I had called since Jim's death either—and I would sit down and talks things over with her. I would let her talk about Jim too if she wished, and if it made the world any brighter for her to cry, I would not mind, because if Jim had been working for the company for twenty years or any considerable time, he would have been more or less of a comrade to me as well, and I would not feel so cheerful that his widow's tears would seem entirely out of place. Then I would talk with her about the future and the future of the children, would meet her fear that little Jimmy junior would have to quit high school and begin to earn some money with a suggestion that I guessed we could see that James Junior finished school. I would find out all about her affairs, financial and otherwise, and I would advise her just a bit more carefully than I advised my board of directors about company business and together Jim's widow and I would plan out the things she and hers must do. And then before I left, I would like to hand her a check for $1,000 and that check would not be signed by the Panacea Insurance Company, 2,000 miles away, either. It would bear the legend "Ringville Power Company by H. A. Lemmon, Manager." It isn't so much what you do, as how you do it.

LET US LEARN EVEN FROM TAMMANY

It is very interesting to learn what this company and that company are doing to tie their workers to them, but my own personal opinion is that I shall seek for knowledge in an entirely different quarter—Tammany Hall. Give me twenty minutes' observation and study of the history of Tammany Hall, and as far as I am

concerned, you can burn the libraries on industrial relations, and the country's greatest industrial organizations won't need to copyright their own pet systems on my account. Tammany Hall does not send booklets about the cold-pack method of preserving tomatoes where the family of a faithful follower is out of food or requires medicine. Instead, it sends food and shoes and money when it's needed. Now, of couse, if I know anything about the financial end of operating a company I would know that it is not business to loan money to employees, that you will lose most of it if you do, and, besides, the act will accomplish no good purpose. The whole thing is unsound and unscientific. There is nothing wrong about this statement, as an item of news except that it is old. It is strange that some managers have been so slow in comprehending a fact as self-evident and so generally conceded, and just because they are not losing any considerable amount of money, they make loans to distressed employees, and I suppose they will continue to go through life not knowing how impossible their success is.

Tammany Hall holds its rank and file through thick and thin, because it treats them in a thoroughly human manner and because it does not know the meaning of the term "industrial relations." Tammany does not always capture enough votes on the outside to win every election, but it goes into the fight with a united family, and, come to think of it, its batting average is not so far from 1,000 at that. And so, as between the Professors, who really would not know a family spirit if they met one in a bottle or in a churchyard, and the very wise, subtle, human politicians, who handle Tammany Hall, my money goes on the Hall.

THE INDUSTRY MUST BE HUMAN

The public utility industry has tried politics and failed; it has tried legal battle and failed, and now if it is to survive, it will try the only thing which has ever had a chance to win and which since man was first created has never failed—the human touch. If we think people are fundamentally unfair, dishonest or unintelligent, then we should immediately get out of the utility business, for as the people are, so they have been since the beginning, and so they will presumably be to the end. We must climb down from our high horse and get to earth. We must put something besides brains and money into our business. Our most famous American of recent years is remembered because he was human and paradoxically his human weaknesses were his transcendent strength.

Very frequently some man or some corporation or some government thinks it can ignore human nature and the human touch. Disastrous failures follow, and they always will. Every Manager to-day is confronted with the choice of humanizing his organization or of wrecking it. He cannot drive his public, but he can lead it. A community is built up by men who give more to it than they take out. Companies will be built up by managers who put more of themselves into their organization than they take out To accomplish what we are seeking

we must know the human side of our business—not only the managers must know it, but the cashiers, meter readers, collectors and clerks. These people are really the company to the public, and it is that same public which pays or refuses to pay our salaries, and a return upon our stockholders' investment. We must abandon the idea that these are little jobs and that any one can fill them. In all solemnity, it is easier to furnish a manager for a new company than a telephone girl who will handle that job as it should be handled.

The secret of the whole thing—if it be a secret— is to be found in taking care of the little things, the minor points of contact with people. Very small keys will unlock very large doors, both in an organization and in a community. If the little things are perfected there will not be any big problems to solve. We cannot properly exist on legal battles, on increasingly vicious legislation, or unwarranted financial assistance, on mistrust, on misunderstanding. We can prosper and give real service to the public when we gain its confidence—its good-will. We can gain good-will by being human. The man who does not recognize this fact was behind the times the very moment that Eve threw away the first apple core and human nature became an established fact.

The thoughts expressed by Mr. Lemmon and also by *The Electrical World* in its short editorial, have been deemed worthy of repetition by the Hydro-Electric Power Commission of Ontario. The "Family Spirit" is one thing that the Commission has endeavored to promote among its employees, and it feels that its efforts have not been without results. It has always endeavored to promote that feeling of personal interest, and is satisfied that there exists among those associated with it a degree of loyalty that could not have obtained otherwise.

Association of Municipal Electrical Utilities

The Summer Convention of the Association will be held at Niagara Falls, Ontario, on June 22nd, 23rd and 24th, 1922.

Members will keep those dates open and come to the Convention prepared to assist in repeating our former successes.

The Executive

Private Automatic Telephone Exchange of the Hydro-Electric Power Commission

By R. W. Osborne,
Telephone Engineer, H.E.P.C.

THE Hydro-Electric Power Commission, with its two large office buildings separated by two city blocks, its large laboratory and service building staff two and a half miles away, and connections with over 2,000 miles of private long distance lines, covering about 25,000 square miles of territory in Western Ontario, presents communication problems not usually met with in other organizations.

Previous to the installation of the new automatic telephone system, the Commission had a small 50-line automatic system supplemented by some manual equipment for connection between the various offices and the private long distance lines on the Niagara System. A private branch Bell exchange (P.B.X.), consisting of an 80-line board and a 30-line board at the main office and a 30-line board at the Strachan Avenue Service Building, provided a service to the city exchange besides handling a large proportion of the intercommunicating traffic. The city exchange traffic amounted to about 1,200 calls per day. The steady increase in the staff and the occupation of buildings outside the main office placed an increasing demand for intercommunicating service upon the Bell P.B.X. This intercommunicating traffic, which amounted ultimately to about 800 calls per day, interfered seriously with the efficient handling of the city exchange calls.

After careful study of the traffic and service requirements, it was decided that in the interests of efficiency the P.B.X. should be entirely relieved of intercommunicating traffic and that a more modern P.B.X. should be installed at the main office. To accomplish this it was necessary to install a modern intercommunicating system with means for connecting any tele-

phone in the system with the private long distance lines. It was required that this private service should be a 24-hour service and it was found that this requirement could be met best by the installation of an automatic system with night trunk connections to Toronto Transformer Station at Strachan Avenue, where an operator is continuously on duty.

An automatic switchboard (P.A.-X.), with ultimate capacity of 1,000 lines on a 10 per cent. trunking basis, 150 equipped, was ordered from the Automatic Electric Company of Chicago. The office long distance board, night line equipment and 150 telephones were supplied by the Stromberg-Carlson Telephone Mfg. Company, Toronto. The automatic switchboard was installed by Automatic Telephones and Time Recorders, Limited, Toronto. All wiring and cabling and the installation of long distance line equipment and telephones was done by the Commission's telephone men. The system was in full operation on the 1st of January, 1922.

The cable and line layout between the different buildings is shown in Figure 1. The automatic switchboard is located in the northeast corner of the main building basement. Two 100-pair lead covered cables extend from the main distributing frame to the distribution box in the centre of the building. A 25-pair cable extends from this distribution box to each of the six floors and a 50-pair cable to the toll board on the fourth floor. A 75-pair cable extends from the main distributing frame to a junction box at the back of the building. A 25-pair underground cable extends from the junction box to a pole on Murray Street for service to the Murray Street offices. A 50-pair cable extends from the same junction box underground to Murray Street and thence overhead down Murray Street to Caer-Howell where it divides, 25-pair going east along Caer-Howell and Elm Streets to the Adminstration Annex and 25-pair down St. Patrick Street to Queen Street where it enters the underground ducts of the Toronto Hydro-Electric System to Strachan Avenue Transformer Station. The latter cable carries the six long distance lines to Dundas and west, the night lines to the Toronto Station switchboard and the local lines serving the laboratory and service buildings.

A No. 12 B.W.G. weatherproof iron wire line extends from the main office building to the residences of the Chief Engineer and the Operating Engineer where automatic telephones are installed.

Automatic telephony has been so completely described in detail by several authors that trunking only will be touched upon here. This system is the only one of the Strowger type in excess of 100-line capacity at present in operation in Ontario, besides being the only private automatic exchange trunking to a toll board for long distance communication. Some special features are embodied in the long distance equipment which will be described in detail.

In a manual exchange the subscribers' lines are divided into groups of a maximum of 10,000 lines, each group usually being in a separate of-

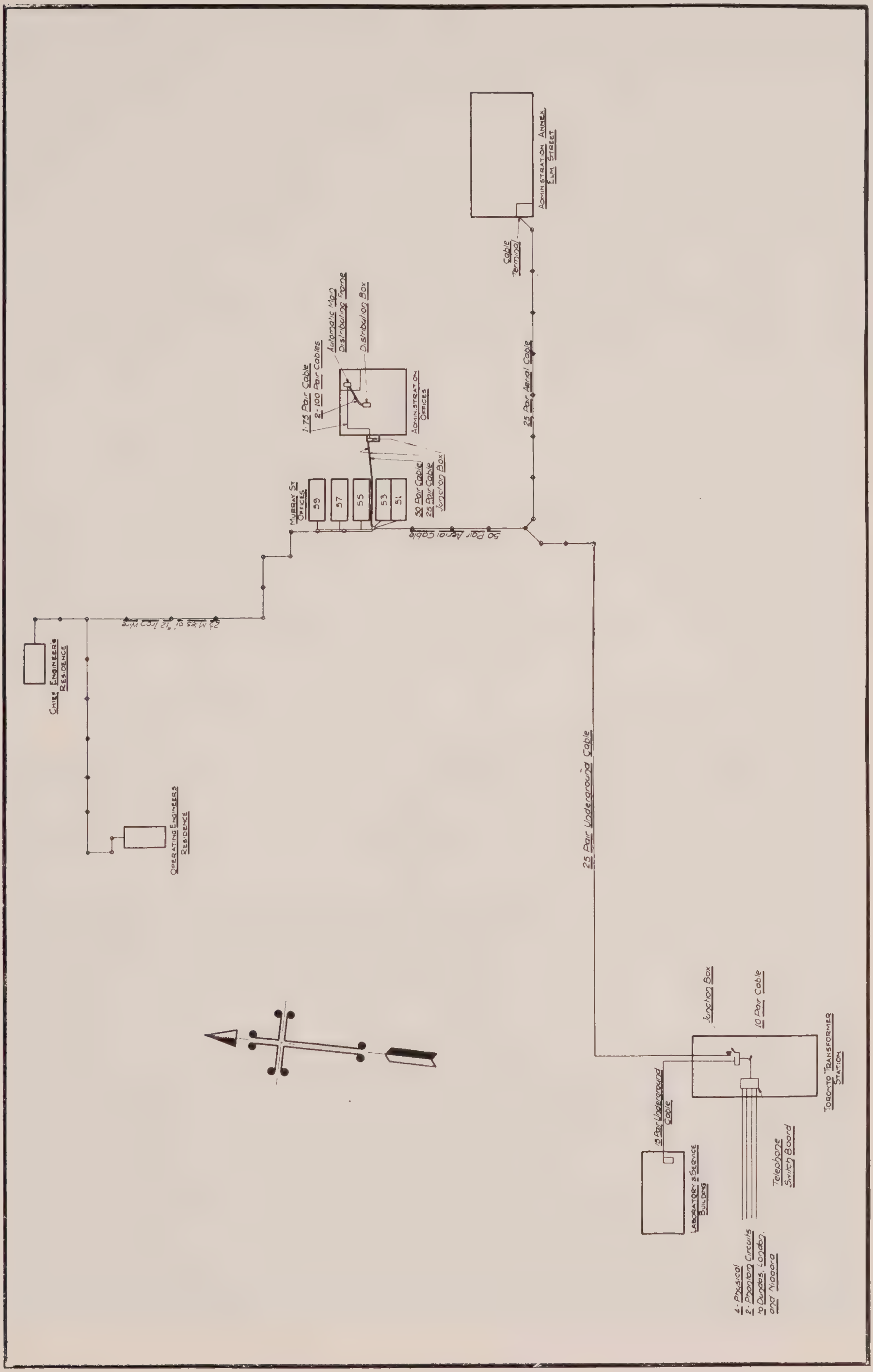

Administration Annex
Elm Street
Cable Terminal
25 Pair Aerial Cable
1-75 Pair Cable
2-100 Pair Cables
Automatic Main Distributing Frame
Distribution Box
Administration Offices
Murray St Offices
59
57
55
53
51
50 Pair Cable
25 Pair Cable
Junction Box
50 Pair Aerial Cable
Chief Engineers Residence
Operating Engineers Residence
25 Pair Underground Cable
Junction Box
10 Pair Cable
Toronto Transformer Station
15 Pair Underground Cable
Laboratory & Service Building
Telephone Switch Board
4-Physical
2-Phantom Circuits
to Dundas, London
and Niagara

Fig. 1

fice. In each office there are the "A" operators who are group choosers, and the "B" operators who are connectors.

In establishing a connection the calling party is first met by an "A" operator in his own office. This operator, after ascertaining the desired number, extends the call through her cord, a trunk jack and a trunk line to the office or group desired. Here "B" operator receives the number from the "A" operator and inserts a trunk plug into the multiple jack of the called line.

The general plan of an automatic exchange divides the subscribers lines into groups and sub-groups. A 10,000-line exchange is composed of 10 groups, each having 1000 lines; each 1000-line group is sub-divided into 10 smaller groups of 100 lines each. This grouping and sub-grouping usually follows the decimal system, thus No. 5464 indicates line 64 in the fourth hundred and the fifth thousand. First the thousand is selected, then the hundred in that thousand and fiinally the ten and unit in the selected hundred.

It is the purpose of this article to describe the principle and operation of a 1000-line system, the scheme of trunking for which is shown in Figure 2. For convenience and because of lack of space three groups of each division and sub-division are shown. Each 100 lines constitutes a group, terminating at the line switches which are analagous to the jack and signal of the manual system. Each line switch has access to 10 trunks, the 10 trunks being multipled to a group of 100 line switches. Each trunk ter-

Private Long Distance Board and Bell P.B.X.

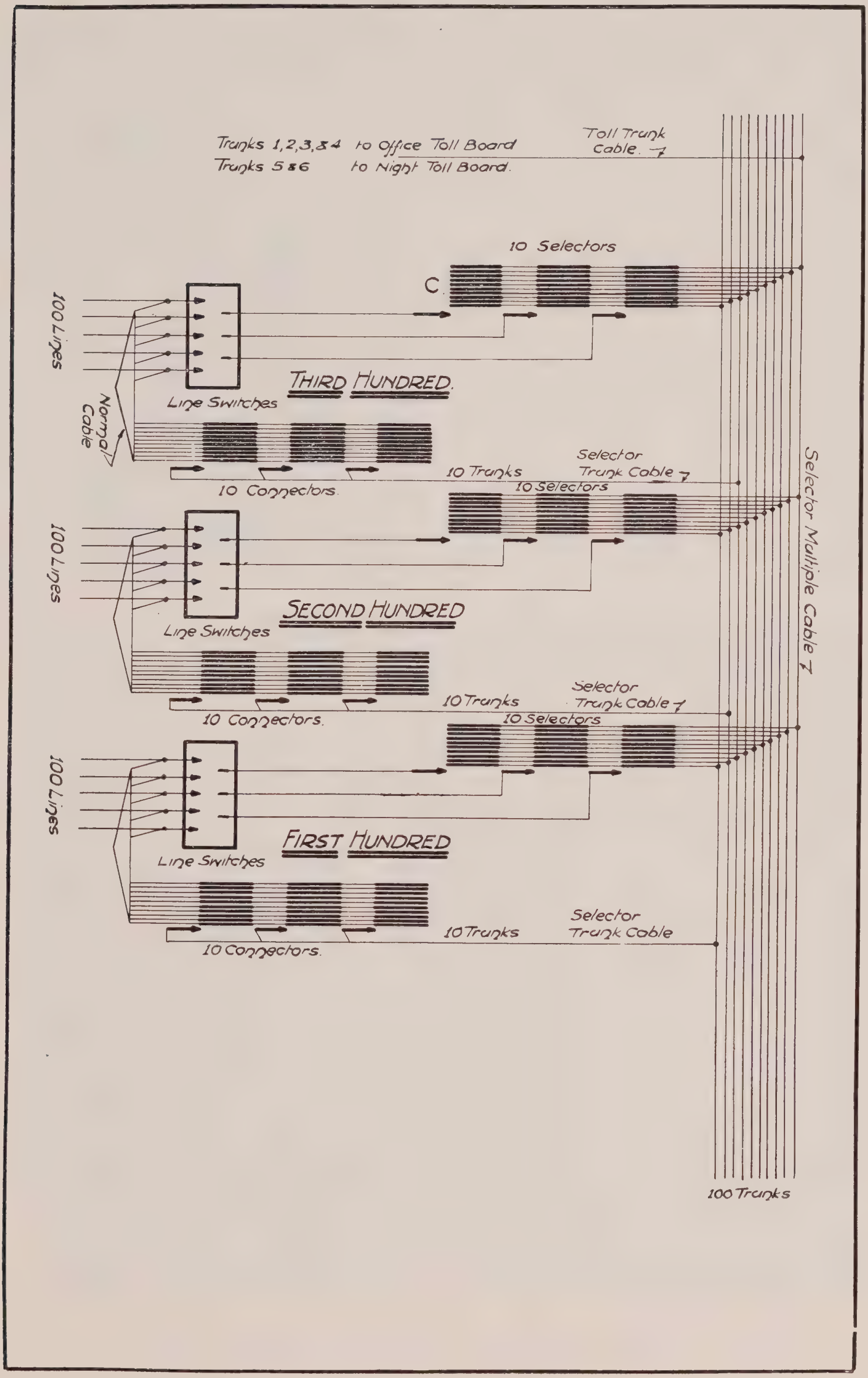

Trunks 1,2,3,&4 to Office Toll Board
Trunks 5&6 to Night Toll Board.
Toll Trunk Cable.
10 Selectors
C.
100 Lines
Line Switches
THIRD HUNDRED.
Normal Cable
10 Trunks
Selector Trunk Cable
10 Connectors.
10 Selectors
100 Lines
Line Switches
SECOND HUNDRED
10 Trunks
Selector Trunk Cable
10 Connectors.
10 Selectors
100 Lines
Line Switches
FIRST HUNDRED
10 Trunks
Selector Trunk Cable
10 Connectors.
Selector Multiple Cable
100 Trunks

Fig. 2

minates in a selector and 10 selectors are assigned to each 100 lines. A selector has access to 100 trunks through its contacts, which are arranged in 10 semi-circular rows of 10 pairs of contacts each. The 100 trunks are multipled to all the selectors. The other end of each trunk terminates in a connector, 10 connectors being assigned to each 100 lines. The bank contacts of the connector are arranged similar to those of the selector and the 100 subscribers' lines belonging to that group are multipled to 10 connectors.

If a subscriber in the second hundred desires to call No. 345 he takes his receiver off the hook when the line switch associated with his line immediately seizes an idle selector of the ten in the second hundred group. He dials 3 which causes three impulses to be transmitted to the selector vertical magnet which lifts the wipers to the third row of trunks. Then the wipers are automatically rotated until they seize an idle trunk leading to a connector in the third hundred. He dials 4 which causes the connector wipers to rise to the fourth row of line contacts and finally he dials 5 which causes the wipers to rotate to the fifth pair of contacts which is the desired line.

The Commission has six long distance lines from the Administration Office building to Dundas. From Dundas, lines radiate to all points on the Niagara System. The six long distance lines, which in ordinary practice would be called toll lines, terminate in jacks at the Administration Office building long distance board. At Strachan Avenue Transformer

Automatic Desk Set

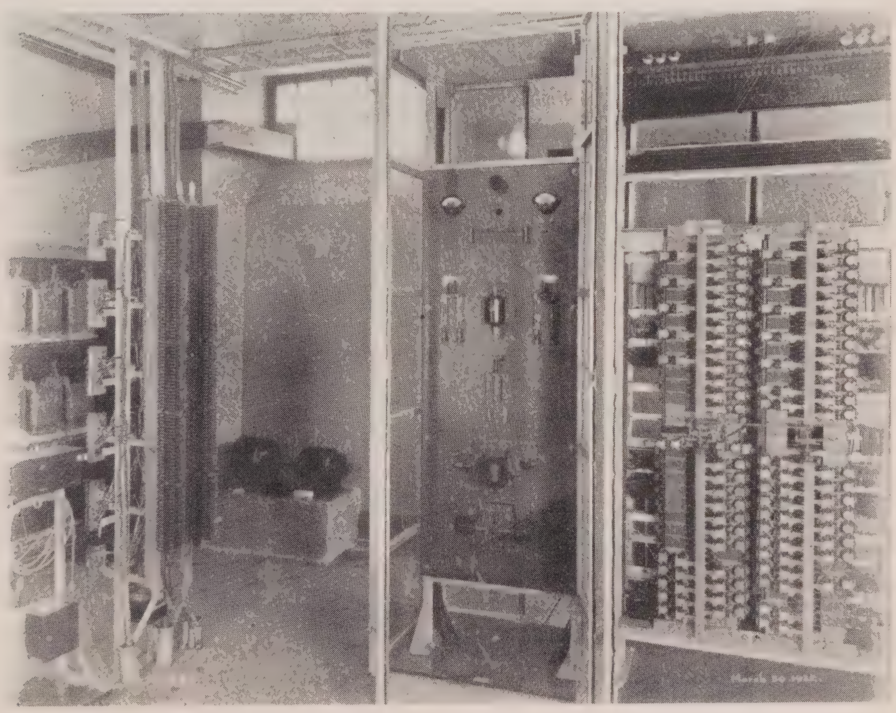
Station another switchboard is installed with its line jacks bridged onto the six main lines. This board is equipped with automatic trunk equipment which will be described later. As operators are continuously on duty here these trunks are used for long distance connection nights, Sundays and holidays.

Referring again to Figure 2 the reader will note that the 10th or "0" level of the selector banks are connected to the incoming trunks of the day and night long distance boards. If a party desires to call the long distance operator he dials "0" and the selector steps up to the "0" level and seizes an idle long distance trunk.

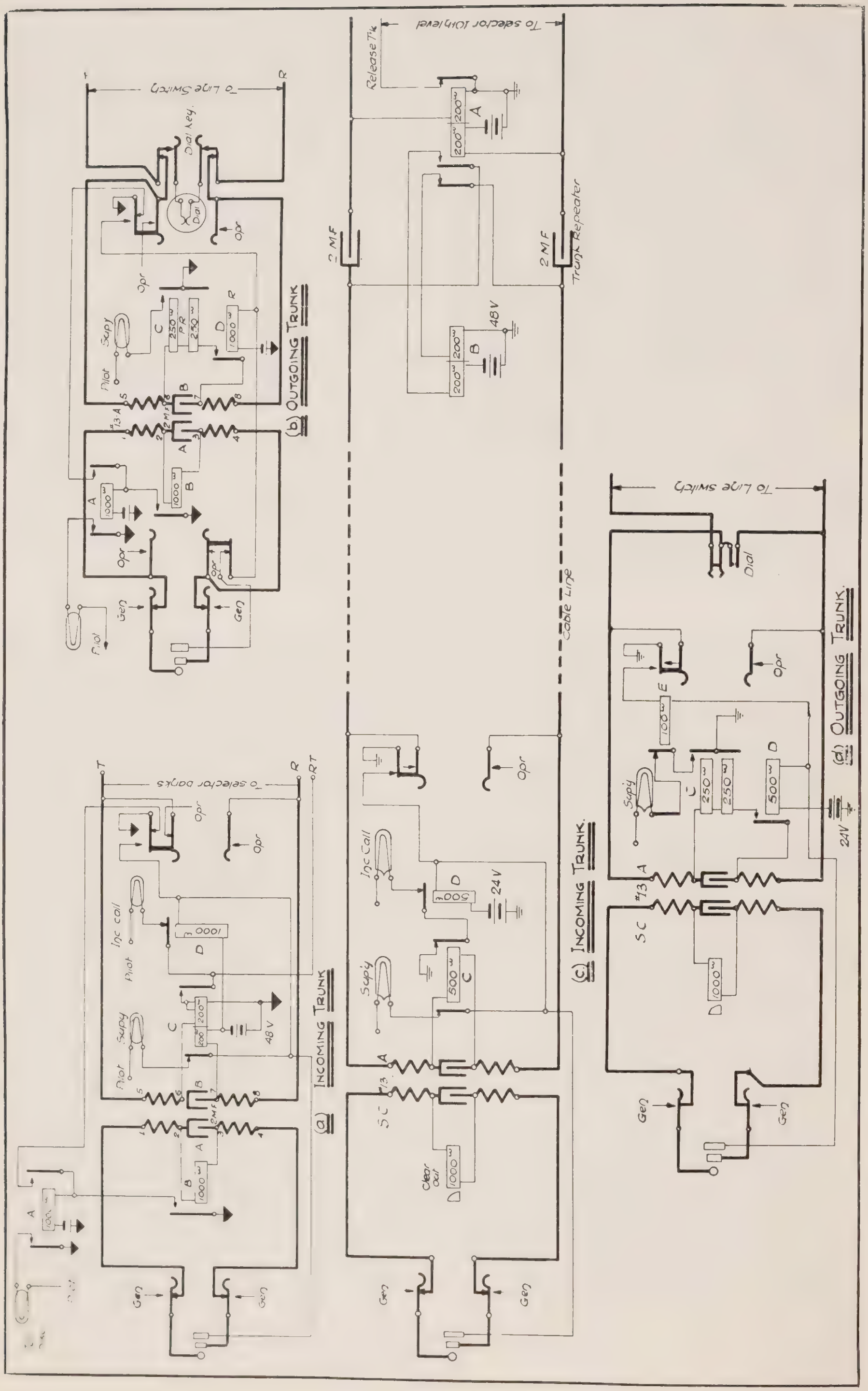
The long distance trunk circuits shown in Figure 3, the design and arrangement of which were proposed by the writer, were made to order.

The incoming trunk diagram "a" and outgoing trunk diagram "b" belong to the long distance board at the Administration Office building. They are of the cord ended type and are made up of standard parts and installed in a standard cabinet.

If a party calls the operator by dialing "0", the selector seizes the first idle trunk and talking battery is fed through relay "C" to the telephone. This relay pulls up its armature and grounds the release trunk which holds the selector and guards the trunk. Ground or positive battery is also supplied to the incoming call lamp which attracts the operator's attention. When the operator listens in, relay "D" is energized from battery to ground at the operator's key. At the same time ground is put on the supervisory contact of relay "C" in parallel with the sleeve strand of the cord for operation of the supervisory lamp when the calling party hangs up his receiver. The call is extended to a toll line by the operator inserting the plug in the line jack and operating the generator key. The sleeve of the jack being grounded, supervisory ground is supplied to the sleeve strand of the cord. When the calling party hangs up his receiver relay "C.' releases its armature and the supervisory lamp lights indicating that the conversation is finished. If the operator neglects to make prompt disconnection, toll line clear out may be accomplished by the



One Line-switch Unit, Power Panel, Motor Generator Set, Main Distributing Frame, Test Set and Storage Battery



To Line Switch
Dial Key
(b) Outgoing Trunk
To selector 10th level
Release Tk
Trunk Repeater
Cable Line
To selector banks
(a) Incoming Trunk
(c) Incoming Trunk.
To Line Switch
(d) Outgoing Trunk.

Fig. 3

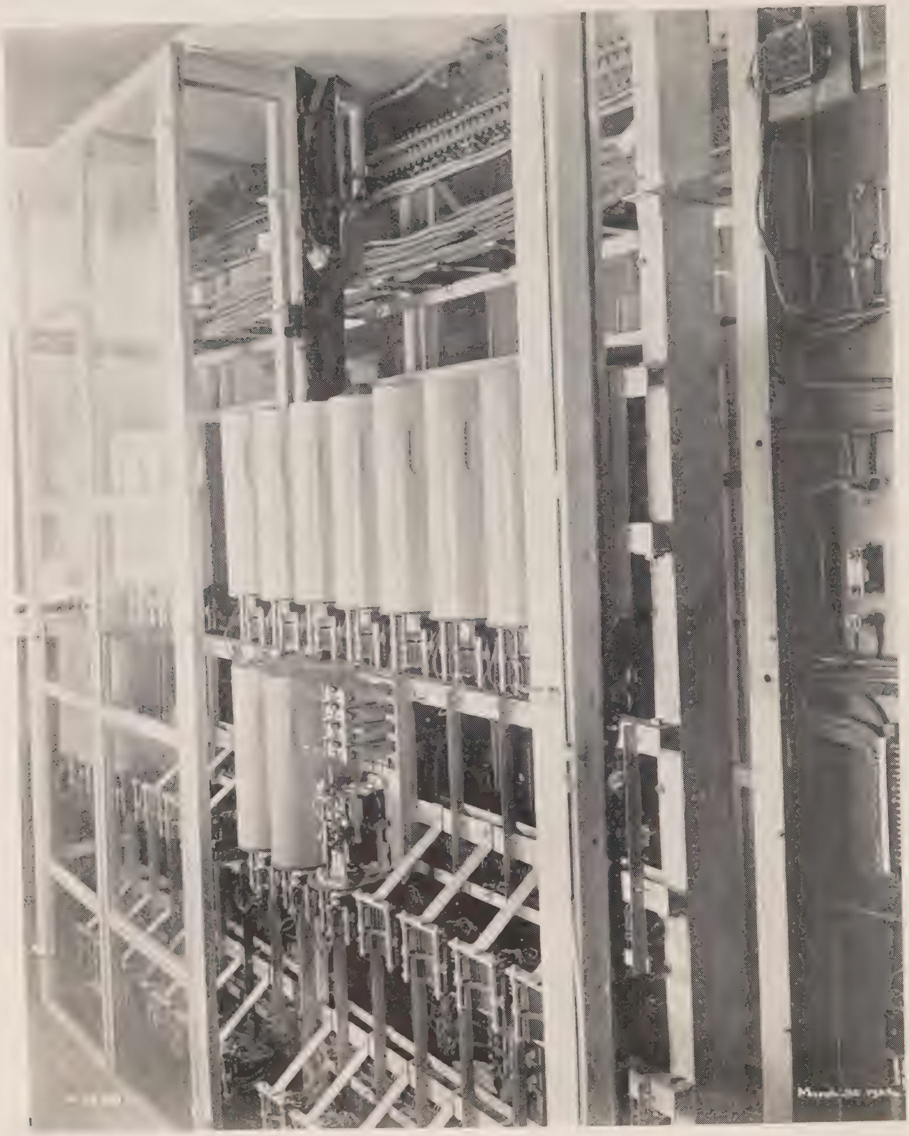
party at the other end of the line ringing in. This operates relay "B" followed by relay "A" and the lighting of the toll disconnect lamp .

Diagram "b" indicates the outgoing trunk from long distance board to the automatic exchange. The long distance line calls are answered from this trunk by the operator putting the toll listening key forward and inserting the plug in the calling long distance line jack. The call is then extended through to the automatic party by restoring toll listening key and pulling the dial key forward and dialing the called party's number. When the dial key is restored the relay "D" is energized from negative battery to ground through the sleeve strand of the cord. The automatic line is held through the 500 ohm polarized relay P.R. Before the called party answers current flows from the feed relay of the connector switch through relay P.R. in such a direction as to hold the relay contacts closed to the supervisory lamp. When the called party answers battery is reversed through the relay P.R., the armature swings in the opposite direction and the lamp goes out. When the called party hangs up his receiver, battery is again reversed to normal and the supervisory lamp lights indicating that the conversation is finished. The long distance supervision is effected in the same way as with the incoming trunk.

Diagram "c" indicates the incoming trunk equipment at Strachan Avenue Transformer Station. To avoid using a third wire for each trunk in the cable between the Administration Offive building and Strachan Avenue a three to two wire repeater was installed on each of the two trunks at the office end. Relay "a" of the repeater functions as a feed relay for the talking current besides grounding the release trunk and closing a circuit for signal battery through impedance "B," cable line and relay "C" at the Toronto Station end, otherwise the operation of circuit "c" is similar to circuit "a."

Outgoing trunk "d" on the Toronto Station board functions the same as trunk "b" except, that there being only one trunk, no dial key is required.

The four incoming trunks "a" at the Administration Office building occupy positions 1, 2, 3 and 4 on the 0 level of the selector bank multiple. The two incoming trunks "c" occupy positions 5 and 6 on the same level. In order to place the night lines in service, it is necessary to ground the release trunks of the four trunks "a" then the selector will step over to 5; if this is found busy it will step to 6. Automatic grounding of release trunks "a"' is effected by replacing the impedance coils, through which battery is fed to the operator's set at the Administration Office building board, with relays provided with contacts to which the release trunks are connected. These contacts are so arranged that they connect the release trunks to ground when the relays are de-energized. When the operator removes her set from the board the release trunks are therefore grounded. At the same time all the incoming call lamps light up, indicating that the battery switch is not open. The possibility of the operator neglecting to remove her set and open the battery switch is very remote, and if she attends to



Connector Side Showing a Connector with Cover Removed

either duty without attending to the other the night trunks are made available.

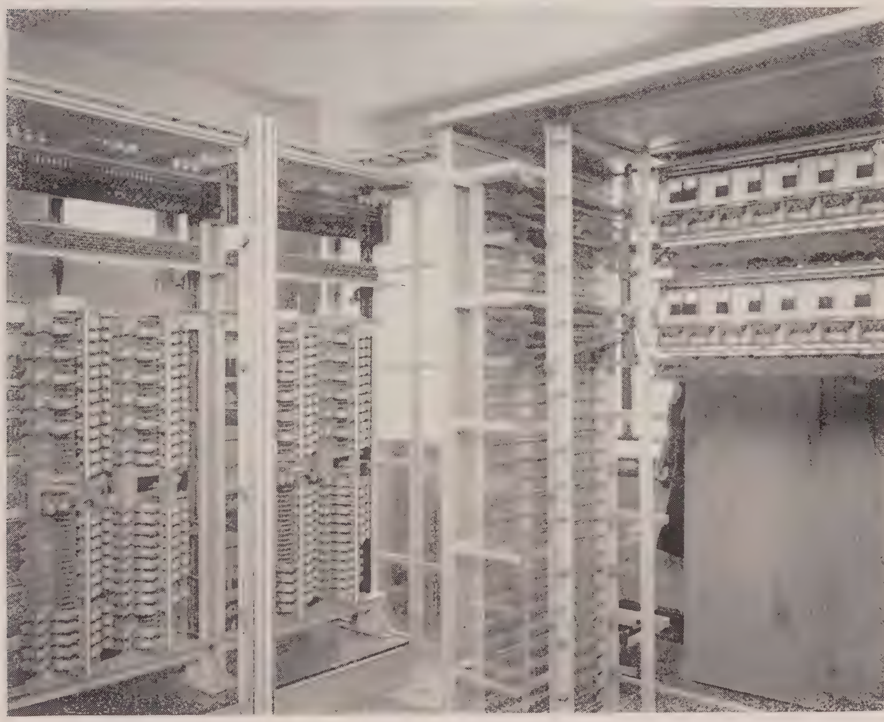
The accompanying half-tones show different views of the automatic switchboard equipment, also private long distance board and the new Bell multiple P.B.X.

A cut of desk telephone is also shown. This set has the advantage

over most automatic desk telephones in that the dial will not touch the floor if the telephone falls.

The automatic system meets the needs of the Commission's organization in a very adequate manner and the staff have nothing but praise for the efficient service it renders. A record of the traffic growth from the first would have been interesting but unfortunately the meters were not installed until the middle of February. The first day's record showed 1,100 calls. The daily records show a steady increase in traffic throughout the balance of February and March. The average daily calls are now about 1,400 with peak days of 1,600 which is about double the intercommunicating traffic handled before the automatic system was installed.

The transmission qualities of the equipment is especially good. Long distance communication with the farthest away points, like Chatham and Windsor, is carried on with ease.



Line-switch Units and Trunk Board

Laboratory Tests on Electrically Heated Water Installations

IN the January issue of the Bulletin, an article was published under the above subject, and since that date further investigations have been conducted in order to obtain data. The investigations have reached a stage now when we may again take up this interesting subject.

If the reader will refer to the previous article he will find the main feature of the tests recorded was the investigation of efficient insulation. It was stated in conclusion that this required a more complete analysis if the use of electrical heaters is to become general.

It has become customary to insulate tanks for the purpose of conserving the heat stored in the water, especially where low capacity continuous heaters are used. No thorough investigation of the efficiency of the insulation seems to be available. What has been adopted for installations seems to be the outcome of practical experience without thought as to whether the most efficient material is used, or whether an adequate amount of insulation is put on the storage tank and heater.

It is evident to the reader that one should aim to prevent losses in the case of electrical water heaters, because the kind of heating energy used is costly. The convenience, utility, cleanliness, etc., of electric heating justifies this method even at greater cost over other ways of doing the work. It does not excuse inefficiency, however. Furthermore, if losses can be reduced, the scope and field of economic use can be enlarged. This in itself justified a more thorough understanding of the problem. It is evident that if a great proportion of the energy input can be conserved in every installation, the use of this method of water heating can be extended to districts where higher unit costs of electricity are prevalent. From such indications as are at present available, it is evident that over half the energy is lost on every electrical hot water installation, even in those which are considered as well insulated. If the greater part of these losses were prevented, the economic field of use could be extended to districts where costs of electricity are double those prevalent in areas where the economic use has prevented extending it.

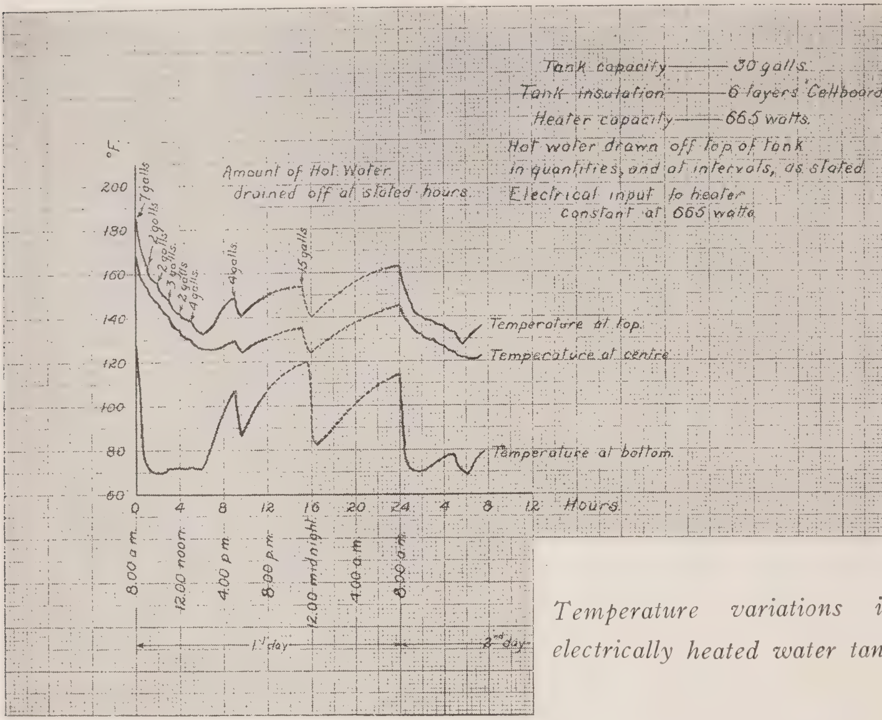
Some questions which arise in the investigation had to be more or less definitely settled in order to have a basis for proceeding. The question of how hot should the water be kept is one which will receive various answers. The losses of the heat storage depend greatly upon the temperature at which the water is kept. In our tests we have retained a temperature of 100 degrees rise above room temperature. This might be considered too high by some. It certainly may

explain why there were excessive losses in our results. We find a contemporary writing on this subject adopting the same range of temperature, however. Another feature which enters into the problem is the quantity of water used daily by the average family for domestic use. The amount of variation from average conditions which one should assume is also a question upon which there is little data available. Another important question is the maximum instantaneous demand or demand for short intervals which is commonly met with. It is evident that if the demand were continuous at an average rate, no storage tank would be required, there would be no heat loss and many of our problems would be eliminated. The ordinary requirements of the house might be met by having a very small hot water tank and heater with low attending losses, but this leaves unsolved the requirements for excessive daily demands for large quantities during short periods, and weekly demands of similar nature such as wash day conditions exact. The question therefore arises as to whether the common hot water equipment met with in the home to-day lends itself suitably to efficient electrical heating, and whether the owner could afford to abandon it for better equipment should it be conceded that such were available.

We have had to eliminate a lot of these questions in order to get progress in our investigation, and have chiefly devoted our work toward conserving efficiently the heat input, so that the maximum amount would be available for ultimate use. This phase of the subject has a direct effect upon electric heaters of the low capacity continuously used type which can be permanently connected to operate at 100 per cent. load factor and on a flat rate varying with varying cost of power.

In the previous article a schedule was adopted to represent the average domestic requirements for hot water in the home, and Curve Sheet No. 1 showed the effect of using this schedule for one day only. This test was repeated to get the effect of following the schedule for several days. It was desired to know what the average temperature would be under daily use of this quantity of water. Curve Sheet No. 6 shows the results of this test and contains all the information, setting out the conditions upon which the test was conducted.

From data collected and further tests made, a series of curves were drawn showing the watts lost at various temperature ranges, using different thicknesses of insulating material. Curve Sheet No. 7 shows information collected in this investigation. From this the reader can see the effect of neglecting to insulate the tank. The curves show a rapid reduction in losses, with increase in insulation, and it occurred that we should investigate at this stage what should be the economic thickness of insulating. Some figuring was done on this, and allowing power at Forty to Fifty Dollars a horsepower year, we assumed that a very low loss in heat would soon compensate for extra cost of insulating to a greater thickness than 2 inches of hair felt. We thought that probably a considerable improvement



Temperature variations in electrically heated water tank

Curve Sheet No. 6

might be obtained in saving the heat by increasing to 3 inches of hair felt, so we proceeded to investigate with thicker insulation, and to properly record these investigations. A curve was plotted, showing different losses with varying thickness of hair felt.

An attempt was made to reduce the losses by increasing the thickness of the insulating material, and tests were conducted using various thickness of hair felt on the 30 gallon tank. We have made a number of measurements of radiation losses, having the temperature of the water at the top of the tank constant at 100 degrees above the room temperature.

The pipe leading from the bottom of the tank to the heater and also the pipe leading from the heater to the top of the tank were covered with felt to the same thickness as the tank, but the pipe which would lead water to the faucets was not lagged in any way.

During these tests all of the power supplied was dissipated in heat radiation; there was not any water taken from the tank.

In the cases where the thinner lagging was used, the temperatures were allowed to become constant (48 hours run) with various values of input watts and from the curves plotted with these results the watts required to maintain 100 degrees (Fahrenheit) temperature rise were read.

With the 2-inch and 3-inch thicknesses of felt, the input power was adjusted to keep the temperature of the water at 100 degrees above the air temperature.

The attached curve sheet No. 8 gives the results of these tests expressed as radiation losses in watts on the basis of thickness of felt lagging used, and it will be observed that there is very little reduction effected in these losses by increasing the number of layers of felt beyond four, which equals approximately 2 inches in thickness.

From our previous test results we obtained the point "A" which is the radiation loss for 100° temperature rise with 6 layers of cellboard ,approx. 1.2 inches) but we have not carried on a series of tests with this type of lagging as we were not interested in it only from a relative efficient view point.

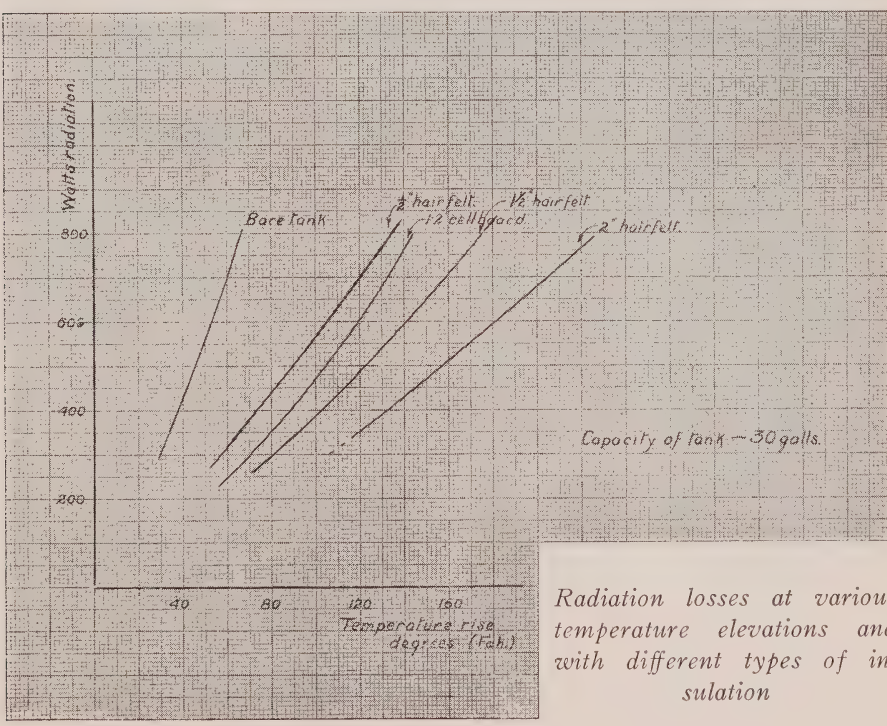
Following this test an investigation was made to determine the results of using alternative layers of cellboard and hairfelt. The installation was lagged as follows:

Two layers of cellboard next to the tank.

One layer of hair felt.

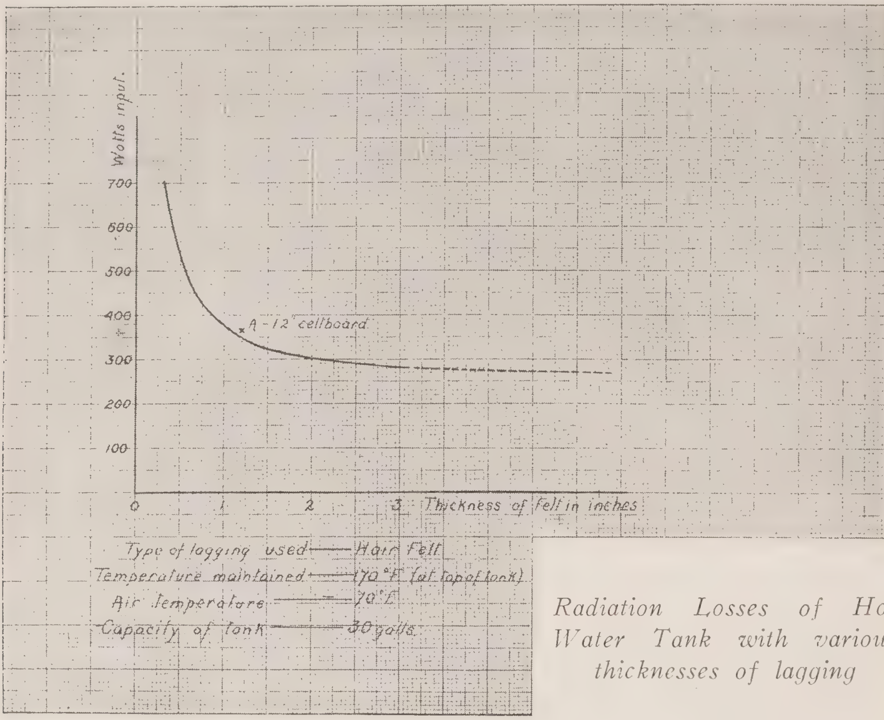
Two layers of cellboard on outside of felt.

With an air temperature of 73° F., and the water at the top of the tank kept at 173° F., the radiation loss was found to be 442 watts.



Radiation losses at various temperature elevations and with different types of insulation

Curve Sheet No. 7



Radiation Losses of Hot Water Tank with various thicknesses of lagging

Curve Sheet No. 8

This loss with the combined cellboard and felt is about 80 watts higher than the radiation loss with the same thickness of 1.3″ of cellboard alone and about 100 watts higher than the loss with equal thickness of felt lagging alone.

As in the previous measurements of radiation loss, no water was drained off the tank during the test.

We are now investigating other materials to find better insulating qualities. While there may be other materials which have given equally good results, we find that hair felt is as good insulating material as we have yet investigated.

It has also occurred to us that some effective means might be undertaken economically of reducing radiation losses. We are painting the tank with a coating of white enamel, after determining the amount of radiation without such a coating. It is also suggested that a tank constructed on the Thermos bottle principle might be a success. Dead air spaces might result in considerable reduction of losses.

In conclusion, we are compelled to admit that the losses cannot be reduced in the better insulated systems under 300 watts, which represents a considerable amount compared to the useful portion of the energy. The efficiency of the installation as a heat

storage plant is very low. We have to concede that practically half of the rated capacity of the heating element is utilized to supply a loss. Half the monthly bill for hot water heating is to meet losses. The field of economic use is restricted to half.

Some radical method of arresting this loss must be met by change of the standard hot water equipment in the home, if an insulating material cannot be found to meet the needs. Larger storage systems operating at lower ranges of temperature would only result in a race between trying to reduce loss by reduced temperature and increase of loss due to increased area of radiation.

If any further data of interest is derived from our investigations, we will follow this article with more information.

Niagara Falls, Canada,
March 6th, 1922.

Mr. G. D. Floyd,
Assistant Laboratory Engineer,
Hydro Electric Power Commission,
University Ave., Toronto, Ont.

Dear Sir,—

I have read with much interest your article on page 23 of the January Bulletin of the H.E.P.C.

From the point of view of economy it would appear that the most important point brought out by your experiments is the necessity for putting sufficient heat insulation around the tank.

To carry the idea to its logical conclusion it would appear to be necessary to provide similar lagging around the pipe leading from the tank to the point of delivery of the hot water. In the ordinary course it is necessary to draw off several gallons of cool water before obtaining a supply of hot water from the tank. In other words, the connecting pipe must be filled with hot water before any becomes available. The quantity of hot water remaining in the pipe might be retained at a usable temperature for some considerable time if the pipe were suitable lagged.

One very important source of loss has not been referred to in your article. Possibly you have it in mind for future reference. In many cities it is a common experience for the pressure to be taken off the city mains, whereupon the water in the domestic system gravitates and siphons back into the mains. This includes in many cases the fifteen or twenty or thirty gallons of hot water in the tank, and of course the heat is lost permanently.

It would seem necessary on the score of economy to insert a non-return valve in the supply pipe, and, in order to prevent accidents, to fit a safety valve somewhere in the domestic piping system.

I should be interested to know if you have any definite recommendations to make on this point.

Yours truly,
The Herbert Morris Crane & Hoist Company, Ltd.
(Signed) M. R. MELDRUM.

8 Strachan Avenue,
March 9th, 1922

Herbert Morris Crane & Hoist Co., Ltd.,
Niagara Falls, Ont.
Attention Mr. R. Meldrum

Gentlemen:

I have your letter of March 6th, and note the comments which you have made on my article in the January Bulletin of the Hydro-Electric Power Commission.

There is no doubt that lagging the pipes leading from the boiler will increase the efficiency to some extent, depending on the length of pipe and on the thickness and quality of insulation applied. The quantity of water contained in 30 feet of ½-inch pipe would be approximately ½ gallon, and if this water was allowed to cool from 160° F. to 60° F. the heat lost by cooling would be 500 B.T.U. or 146 watt hours. On the schedule given in the paper there were 8 operations per day, so that the total heat lost from the pipe would be 1170 watt hours. For the 660 watt heater the heat applied would be 15,800 watt hours, so that the loss from the above source is only 7% for the case where the water is cooled to room temperature. This loss could not be all overcome by applying insulation because there would be a loss of heat through this; and the greatest saving that could be obtained would probably be not more than 3 or 4%. Even this could not be realized if the temperature in the pipe would become less than 100°, because water at this temperature or lower would be drained away in any case by the average householder.

Your comment regarding what occurs under loss of water pressure is an opportune one. Loss of water from the boiler to the main is only likely to occur if a tap on the system is left open, or if there is a leaky tap, through which air can enter the pipe line. If loss of water occurs from the above cause, there is danger of the element in the heater burning out, if the temperature of the heater rises very high before the circuit has been opened.

Two alternatives are available to take care of loss of water pressure: (1) To instruct the user of the heater that in the event of loss of pressure the heater should be turned off and no taps opened. (2) To provide a one way valve and safety valve as suggested in your letter. The former should cover the majority of cases, while the latter is a surer but more costly arrangement. I do not think any definite recommendation could be made covering all cases generally. The number of times that water pressure will fail during a year is few, even in small towns, so that the economic feature is not important, as the actual loss to the total heat generated is small. Other factors, as those pointed out above, are important, and should be considered, so that the point you made is worth consideration.

I wish to thank you for your interest, and for the points you have brought to my attention, and I shall be glad to bring the latter to the attention of our engineers who are interested in this problem at the present time.

Yours very truly,
G. D. FLOYD,
Asst. Laboratory Engineer.

Rates for Electric Water Heaters

The developments made by the manufacturers in Electric Water Heaters have continued to keep the fact before us that we are being faced with a new class of service that must be given serious consideration. One of the chief phases of this service in so far as the ultilities are concerned is the charge to be made for such service.

Rates for electric water heaters have been given considerable thought and a number of suggestions have been made for a method of billing. These suggestions, though working in the right direction, were not deemed to be final and suggested that further study be made.

A Committee of the Association of Muncipal Electrical Utilities discussed the suggestions at a meeting held early this spring, and recommended that the Commission's engineers bring in a proposal that would embody the following conditions:—

1. The rates are to encourage the use of low capacity heaters.

2. Flat rates are a correct form of rates for this class of service.

3. The flat rates must be low enough to encourage the use of heaters, yet high enough to meet the cost of service.

4. It is assumed that there is no diversity from the water heater load, and that at least 75% of the heaters are on all of the year.

Recommendations based on a study of the question along the lines given were submitted to the various members of the A.M.E.U. Rate Committee for comment. These having brought forth favorable replies, the Hydro-Electric Power Commission have approved of the following basis for billing for service to electric water heaters.

Where power is delivered to a Municipality at 2,200 or 4,000 volts, the rate for electric water heaters shall be—"The cost of power to the Municipality, plus at least $7.00 per h.p. per year."

Where power is delivered to the Municipality at 13,200 volts or a higher voltage; that is, where the Municipality owns its own step-down transformer station, the rate shall be—"The cost of power to the Municipality, plus at least $10.00 per h.p. per year."

The actual rates to be charged for electric water heaters have been left open and may be applied in various Municipalities on a sliding scale, depending on the cost of distribution in each Municipality. The recommendation by the Commission is a minimum and may be increased in municipalities where the local operating conditions warrant such increase. It is to be distinctly understood, however, that all rates for electric water heaters, in all municipalities must be approved by the Hydro-Electric Power Company of Ontario, before being put into force.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES

Minutes of Meeting of Executive Committee

The meeting was called to order at 2 p.m. on April 20, 1922, at the office of the Hydro-Electric Power Commission of Ontario, by the President, Mr. M. J. McHenry. Others present were Messrs. J. J. Heeg, A. T. Hicks, W. E. Reesor, O. H. Scott, H. F. Shearer, E. J. Stapleton, E. V. Buchanan, R. T. Jeffrey, G. J. Mickler and S. R. A. Clement.

Moved by Mr. O. H. Scott, Seconded by Mr. H. F. Shearer, That the minutes of the last Executive meeting be passed. *CARRIED.*

Mr. Jas. G. Reid, Manager of the Bigwin Inn, addressed the meeting with the object of getting the Association to hold its next Convention at his hotel. The proposal to hold the Convention at Ottawa with joint sessions with the Canadian Electrical Association was also discussed.

Moved by Mr. O. H. Scott, Seconded by Mr. E. J. Stapltor, That the next Convention of the Association be held at Niagara Falls on June 22, 23 and 24, 1922. *CARRIED.*

A letter from Mr. K. A. McIntyre, Canadian Representative, Society for Electrical Development, asking for permission to address the next Convention of the Association was read.

Moved by Mr. A. T. Hicks, seconded by Mr. J. J. Heeg, That Mr. McIntyre be permitted to address the Association at its next Convention. *CARRIED.*

Suggestions for papers to be read at the Convention were presented and discussed.

Moved by Mr. J. J. Heeg, seconded by Mr. E. J. Stapltor, That papers be presented at the June Convention on the following subjects:—(1) Street Lighting; (2) Accident Prevention; (3) Health Promotion; (4) Construction Accounting. *CARRIED.*

Moved by Mr. W. E. Reesor, seconded by Mr. A. T. Hicks, That Mr. J. W. Bayliss be appointed a member of the Convention Committee. *CARRIED.*

In discussing further plans for the Convention, it was suggested that a visit to the Queenston Power House be arranged.

Moved by Mr. A. T. Hicks, seconded by Mr. H. F. Shearer, That details of entertainment be left to the Convention Committee and that the following suggestions be given:—To arrange for a radio demonstration at the Convention dinner, other items to be provided by the members; to arrange for a real baseball game using indoor equipment. *CARRIED.*

There being no further business the meeting adjourned at 4.10 p.m.

Minutes of Joint Meeting of Accident Prevention Committee of C.E.A.

Members present: Messrs. Maclachlan, Chairman; Dunsfield, Clement, Hicks, Cam, Temple, McGregor, Ambuhl, Puxton, Moat, Martin and Vinet.

1. The Chairman stated that the purpose of having a joint meeting of

the two Accident Prevention Committees was in view of the fact that the Conventions of the the two Associations might be held in Ottawa together and problems of general interest might arise to the advantage of the two Committees.

2. It was decided that if one hour can be granted the program of the Accident Prevention Committee for the Convention should consist of a brief report of the C.E.A. Committee and have Mr. Chas. B. Scott, Manager of the Bureau of Safety of Chicago, address the meeting, which would then be followed by discussions on the report and Mr. Scott's address.

The Chairman stated as a matter of interest to the A.M.E.U. members that certain rules in connection with safety for small municipalities were in the hands of the printer and other rules for clearances and such matters were under consideration.

3. It was decided to have at the Ottawa Convention samples of a new type of rubber gloves with shorter fingers, and also shields and blankets in order to have expressions of opinion from delegates. These are to be shown in some form of exhibit, the Chairman to arrange for facilities with the Ottawa Power Company.

4. Mr. Martin offered to send to the Chairman of the Committee the names of the manufacturers of the shields and prices of same as used by the Bell Telephone Company, these to be sent to the members of the committee.

5. Another matter pointed out by Mr. Martin of the Bell Telephone Company, was that his company painted a red band approximately 15 feet in width, 15 feet from the ground on poles where there is danger of any kind so as to warn men climbing such poles.

6. Moved by Mr. Hicks and seconded by Mr. Temple that the executives of the two Associations be requested to take steps to obtain complete elimination of cardboard advertisements on poles of companies with a view of preventing possible accidents to climbers.

7. Mr. Temple suggested that it would seem advisable to discuss at committee meetings accidents happening to employees of the companies there represented and also conclusions arrived at, this with a view of getting information on the subject of accident prevention.

8. The Secretary of the C.E.A. stated that all reports had to be in his hands before May 6th in order to have advance proofs printed and sent to the members of the association.

9. The chairman requested all members of sub-committees to have their reports in his hands within the next ten days.

There being no further business the meeting adjourned.

HYDRO NEWS ITEMS

Central Ontario System

Estimates are being prepared for rates for a supply of power to the Village of Warkworth and surrounding rural district.

Estimates are in prepartion for rates for lighting service to the summer colony at Presqu'Ile Point near Brighton.

Estimates have been prepared and contracts signed for lighting and cooking service for the summer cottages at "Bowmanville-on-the-Lake." It is expected to start construction on the necessary pole lines about May 15th.

The construction of a new pole line in Port Hope, from the sub-station to the centre of the town, has been authorized and construction will start at an early date.

The new water gas generating equipment in Oshawa was successfully placed in operation recently and is operating with marked economy. A number of minor betterments and alterations are being made to the plant and an extensive programme of additions to and enlargement of mains has been undertaken for this season. An active publicity campaign has been carried on to educate the public to the advantage of using gas for cooking.

The Chamber of Commerce of Belleville is to be congratulated on securing the location of the Canadian factory of the American Optical Co. in Belleville.

The distribution system at Lindsay in the district south of Kent St. is to be rebuilt this season and the distribution voltage changed from 1,100 to 4,000 volts in this area.

The Norwood Commission, by an active sales campaign, has increased its number of lighting consumers from 168 to 215. Contracts have also been signed for 40 h.p. in power load. These increases insure the successful operation of the Norwood Hydro-Electric System.

The Marmora Hydro-Electric Commission has taken on a 10 h.p. power customer. Improvements to the street lighting equipment are contemplated.

RURAL

Enthusiastic public meetings were held in Earnestown Township, and active committees were formed to carry out a canvass.

Public meetings with good attendance were held in Kingstown Township, and a canvass is to be made by the committees selected.

A public meeting was held at Sillsville in South Fredericksburg Township. A lively discussion on the proposed rural rates ensued. A few contracts were signed and a Committee was organized with the Reeve, Mr. Elliott, as Chairman, to undertake an active canvass of the municipality.

Estimates are being prepared for a supply of power to mining industries in the vicinity of Harrowsmith in the Township of Portland. This will open up this district to the possibilities of lighting service for the villages of Yarker, Colebrook, Moscow, Enterprise, Verona, Sydenham, Glenvale and the surrounding rural district. It is planned to erect a station near Harrowsmith and extend a 44,000 volt line from a point on the Napanee-Kingston line at or near Odessa, and distribute to the surrounding district at 6,600 volts.

Eugenia System

Mr. E. M. McLeod, Superintendent of the Hydro-Electric System, Kincardine, has submitted his resignation to the Local Commission to take effect June 1st, and the Local Commission has engaged Mr. J. A. Foerester, late of Port Stanley, to fill the vacancy.

A new sub-station has been installed at John E. Russell & Co.'s Sand and Gravel Washing Plant at Durham, located on the property recently occupied by the National Portland Cement Co. This station consists of 3-100 K.V.A. transformers and the company's demand will approximate 300 h.p.

Additional load has been secured by the Local Distribution System of Owen Sound which will bring the total demand in this municipality to approximately 1,600 h.p.

Niagara System

The spring of 1922 will long be remembered by the Operating Department of the Commission. Perhaps, once in ten years we have ice storms in Ontario which demoralize the telephone and telegraph systems, but never before have we had ice storms which seriously interfered with the power lines of the Commission, and the fact that two such ice storms occurred within two weeks of each other has proven that the steel tower lines and pole lines should be constructed with a very high factory of safety. Great credit is due the Operating Department for the energetic way in which the situation was handled, and also to the municipalities who gave assistance in getting the lines back into service.

The trouble due to ice storms was closely followed by an accident to No. 2 generator at the Queenston plant, which will take approximately one month to repair, and last and worst of all came the damage to machines at the Ontario Power Company's generating station, due to the wrecking of No. 15 generator, which

was caused by a faulty casting which failed and partly wrecked machine No. 16, damaging the building and flooding four other generators. The four machines which were flooded will be dried out and put back into service within the next few weeks, and in the meantime the Commission has been able to secure from the various Power Companies at Niagara Falls sufficient power to take care of the requirements of the municipalities.

On the first of March the Commission commenced supplying power to the Dominion Sugar Company at their Wallaceburg Plant. The contract calls for an amount of 1,200 horse-power, and during the month of March the company used as high as 1,400 horse-power. The power is at the present time entirely used for the operation of electric furnaces and supersedes, power generated by gas engines, which the company have been using for a number of years past. The engineers of the Commission have for a number of years assisted the Dominion Sugar Company from time to time in making experiments to prove that A.C. current could be satisfactorily used for the operation of these furnaces, instead of direct current previously used by the Company.

We regret to learn that Mr. H. E. Timmerman has resigned as Manager of the Welland Hydro-Electric System. Mr. Timmerman has been Manager of the Welland System since Hydro was first introduced into that municipality, and is largely responsible for the highly successful operation which is shown by the Welland System at the present time. We understand Mr. Timmerman has taken up other interests in Welland and we wish him every success in his new work.

The lack of wireless communication was keenly felt throughout the Niagara System during the period of the ice storms, when all telephone and telegraph communication were broken, and it is expected that the Niagara System will be well equipped with wireless apparatus before the end of the present year.

Mr. W. C. Rogers, formerly Manager of Carleton Place Hydro-Electric System, has recently been appointed by the Commission as Manager of the Saltfleet Rural Power District, with an office located in Stoney Creek. This is the first rural power district in which underground cable is being used on a large scale. It is estimated that before this district is completed there will be almost 100 miles of underground cable in service.

Rideau System

The Rideau System, a weak and ailing infant in the beginning, is now putting on weight rapidly. The Grenville Crushed Rock Company started taking power in April. This company has contracted for 650 h.p., and expects to take as much as 850 h.p. eventually. The Municipality of Kemptville, which has recently come into the System, is now using about 120 h.p.

It is interesting to note the number of sawmills in this district abandoning their somewhat dilapidated steam plants and installing electric power. They find that the wages of at least one man can be saved, while their output is greatly increased.

Apparently in view of this increasing load, the Mississippi River thought it necessary to put forth a special effort ,and on April 13th the controlling dam on Mazinaw Lake gave way.

By April 21st the water at High Falls had reached a maximum elevation of 616.7. The crest of the dam is 617, and the tail water was flooding the power house. Owing to the fact that a mill owner down stream has a weak dam, our operator was unable to pull all his stop logs. His opinion is that all damns should be strong and hearty.

Mr. Moffat, who has succeeded Mr. Rogers in Carleton Place, comes from the land of gold in the Kirkland Lake District, and has had valuable experience with the Northern Ontario Power Company.

Severn System

A new industry has been located in Collingwood by the name of the Electric Castings Ltd., which will operate an electric furnace requiring some 400 to 500 k.w. It is expected that this plant will be in operation shortly after May 1st. Castings of all descriptions will be supplied to the trade from this plant.

The new plant of the Copeland Flour Mills in Midland has been completed, power being delivered to the company's sub-station at 22,000 volts. This is an entirely new industry in the municipality and will require from 500 to 600 h.p.

Negotiations are being carried on with the Grand Trunk Pacific Elevator at Midland for supplying electric power to replace the present steam plant. It is expected that this plant will be operated by electric power before the end of the coming year, adding approximately 800 h.p. to the load already established in the municipality.

St. Lawrence System

The Commission has started work involving comprehensive changes to the system. The system is being re-insulated to permit operating it at 44,000 volts instead of 26,000. Instead of altering lines running north of Morrisburg to Williasmburg, Winchester and Chesterville, it has been decided to transform all power over this line from 44,000 to 26,000 volts by a station located at Morrisburg. The 110,000 volt station supplying the system, located at Cornwall, is to be extended so as to take care of the growth in loads. Three 5,000 K.V.A. transformers are replacing the three 1,250 K.V.A. ones, which have been in use since the station was built. A number of distributing stations are also being altered to operate at 44,000 volts. Over a Hundred Thousand Dollars will be expended to undertake this work.

The Eugene F. Phillips Electrical Works are constructing their plant at Brockville. The Commission is extending its lines to serve the Company, and the contract has been concluded to deliver the power by June 1st.

The Commission is still carrying on negotiations with several municipalities in this part of the Province, in an effort to get them a Hydro supply. The difficulty met with is the long distance which usually exist, together with the small loads they would likely need.

Thunder Bay System

Arrangements have been made for marketing practically all of the present installation of the Nipigon Development within the coming year. The Kaministikwia Pulp & Paper Company expects to start operations this month, which will increase Port Arthur's demand by some 3,000 h.p., and the company have signified their intention of extending their plant during the year so that within a short time this company will require some 6,000 h.p. The Provincial Paper Mills in this municipality are constructing a paper mill and have served notice on the Public Utilities Commission that they will require 4,000 h.p. to operate same, by May 1, 1923. A new Terminal Grain Elevator is also under construction in this municipality, which expects to be in operation for the next session's grain trade and will require 500 h.p. to operate same. The demand on the Nipigon plant for this municipality in one year's time, therefore, will be in the neighborhood of 18,000 h.p. inclusive of present load and the demands of the concerns mentioned above.

Wasdell System

The Commission has approved the expenditure for extending the Wasdell transmission lines from Cannington to Greenbank, at which latter point an outdoor type of sub-station will be located and 4,000 volt lines will be constructed to serve the municipalities of Uxbridge and Port Perry. It is expected that construction work on the transmission lines and substation will be started immediately, as well as the rebuilding of the Distribution Systems in both municipalities. In all probability, Hydro-Electric power will be delivered to both municipalities before the close of the coming summer.

The demands for power in general on the Wasdell, Eugenia and Severn Systems have now reached the capacity of the three developments which are all operated in parallel, and it has been necessary to make arrangements to purchase surplus power from the plant owned and operated by the Town of Orillia at Swift Rapids. The Commission is giving serious consideration to making arrangements to secure additional power for these systems.

NOTICE

TO ELECTRICAL MANUFACTURERS, JOBBERS AND DEALERS

Electrical material, devices and fittings for use on inside electrical installations in the Province of Ontario, *must not be offered for sale* until their design and construction has been approved by the Hydro-Electric Power Commission of Ontario. (6 Geo. V., Chapter 19, 1916)

Manufacturers whose products are approved and listed by other recognized authorities, and which also meet the requirements of this Commission, may have same placed on the approval list by making application in accordance with Approval Laboratories' Bulletin No. 5, a copy of which will be sent upon request.

ONTARIO DEALERS' ATTENTION IS CALLED TO THE FOREGOING REGULATION—WHICH PROHIBITS THE SALE OF UNAPPROVED ELECTRICAL DEVICES.

APPROVAL LABORATORIES

HYDRO-ELECTRIC POWER COMMISSION
OF ONTARIO

8 STRACHAN AVENUE, TORONTO, ONTARIO

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WATER POWER RESOURCES OF CANADA

The existence of numerous water powers in Canada combined with the natural scarcity of coal, makes the consideration of that portion of our natural resources always of special interest. The report on the Water Power Resources of Canada appeals to us, in that, we are entirely dependent on them. The year 1921 has seen the completion of developments increasing the capacity of available power from such sources by over 12 per cent. The greatest amounts of developed power are found in the Provinces of Ontario and Quebec, the former Province having nearly 45 per cent of that in the whole Dominion.

The turbine installations of the Hydro-Electric Power Commission total approximately 424,000 H.P. or over 15 per cent of the total developed capacity in the Dominion, or 35 per cent of that for the Province of Ontario. Of the 174,000 H.P. added in Ontario during 1921, over 140,000 H.P. came from the Hydro Commission, or nearly one-half of the total for the whole of Canada.

While we are publishing the figures set out in this Report, we do not concur in the comparative figures showing the comparison of the amounts of dependable horsepower available in the Provinces of Ontario and Quebec, as we believe there is a considerable difference in the methods of measurement by which the amounts of dependable horsepower for these two Provinces are arrived at.

With less than one quarter of the minimum available water powers of

Ontario developed, and with the ever increasing demand for electricity, we have still a great deal to do in promoting and extending the work that has already reached considerable magnitude.

THE KITCHENER ELECTRICAL SHOW

The city of Kitchener, the birthplace of the Hydro-Electric principle, has carried to a successful conclusion another idea in the form of an Electrical Exhibition. Although the majority of the booths were for the purpose of advertising electrical goods, that of the Hydro-Electric Power Commission was of an entirely different nature. Its display showed the historical details of the Hydro-Electric Union illustrated by pictures.

First, were those of Messrs. D. B. Detweiller and E. V. B. Snyder, the men who in 1902 made the first move towards obtaining electric power from Niagara Falls. A photograph of the original petition whereby money was raised to secure the services of an engineer to report on the feasibility of distributing the power was also shown. There were pictures of the late Sir James Whitney and of Sir Adam Beck, who turned on the power at Kitchener on October 11th, 1910. Further, there was a display of photographs, drawings and data of the Chippawa Power Development, as well as motion pictures of the Chippawa and Nipigon developments, which were shown and explained each evening.

The exhibit proved itself to be of much interest, fitting in with the whole idea of the show and adding the one detail necessary to make the Kitchener Electrical Exhibition an event in the history of the Hydro-Electric Power Union.

OUR NEXT NUMBER

Before you have received this copy of THE BULLETIN, the Association of Municipal Electrical Utilities will have held another convention. The July number will be devoted to a complete report of that convention.

The papers read will be published as printed for advance circulation together with all discussion following them. The papers are of special interest, the titles and authors being:—

"Modern Street Lighting from Construction and Apparatus Standpoint," by M. B. Hastings, Secretary, A. H. Winter Joyner, Limited.

"Modern Street Lighting from Illumination Standpoint," by R. M. Love, Street Lighting Specialist, Canadian General Electric Co., Limited.

"Some Peculiar Phases of Allocation of Charges for Municipal Electric Utilities," by R. C. McCollum, Auditor, Municipal Accounts, H.-E. Power Commission of Ontario.

The address by Dr. C. J. O. Hastings, Medical Officer of Health for the city of Toronto, on "Public Health as a National and Industrial Asset," and that by Hon. I. B. Lucas, Counsel for H.-E. Power Commission of Ontario, on "Co-operation," will also be published.

With the addition of reports of other happenings during the convention, we hope to make the number one of special interest and profit to all of our readers.

Water Power Resources of Canada

Department of the Interior, Canada
Dominion Water Power Branch

DURING the year 1921 the readjustment of values following war time inflation made substantial progress. This re-adjustment necessarily brought in its train many business and financial difficulties and the lack of confidence in trading circles generally led to a reluctance of capital to embark upon new enterprises. Employment fell off with a corresponding diminution in popular purchasing power and in consequence there has been a general tendency to mark time while re-adjustment advances the further step which will bring costs within the reach of the community, both individual and corporate. The belief seems to be growing, however, that the nadir of depression has been passed and that business conditions are improving slowly but surely, and that though 1921 was a bad year for industry it also saw the turning point safely negotiated.

The hydro-electric industry though naturally affected by the general depression suffered no set-back and in fact the horse power installed during 1921, 300,000 horse power, stamps it as one of the most progressive years in Canadian water power history.

The progress of development is somewhat difficult to follow from year to year because the year is too short an interval. From three to five years or even longer often elapses between the first consideration of development and the delivery of power. Again most projects commence with an initial installation much less than the ultimate projected capacity and new units of machinery are installed from time to time as the load develops. In other words, what we may call the scoring column often does not reflect new construction for some years after such construction has been actively under way, but continues to record new scores from old developments.

The 300,000 horse power installation during 1921 is made up of both kinds of growth and in addition a considerable amount of new construction was initiated which ensures that as old power plants reach their ultimate capacity new ones will take their place in maintaining the continued growth and prosperity of Canadian hydro-electric enterprise.

That Canada is not lagging in water power development may be shown by comparison with the country most comparable in general conditions, i.e., the United States, thus:

WATER POWER DEVELOPMENT PER CAPITA

	H.P. installed per 1000 of population		
	1902	1912	1920
Canada	47	198	280
United States	26	51	93

The total increase in horse power installed in Canada from 1900 to 1920 was 153%.

A brief review of development work in the individual provinces and of progress in investigation and plans will give a clearer view of the general situation.

BRITISH COLUMBIA

The new construction work in British Columbia in 1921 included that of the British Columbia Electric Railway Company, which commenced the installation of a fourth unit of 13,200 h.p. at the Stave Falls plant and the Nanaimo Electric Light & Power Company, which placed in operation a 200 h.p. unit in its Coal Creek plant.

Surveys and investigatory work have been carried on for a development on Bridge River, 130 miles from Vancouver, where an ultimate development of 360,000 h.p. is available. The British Columbia and Alberta Power Company, Limited, has completed plans for the construction of a 6,000 h.p. plant on Bull river in 1922.

ALBERTA

In Alberta a development of 8,000 to 10,000 h.p. at Lake Minnewanka has been studied and surveyed to supplement the plants of the Calgary Power Company, as further power is urgently required in the city and district.

MANITOBA

In Manitoba the City of Winnipeg municipal plant at Point du Bois on the Winnipeg river was increased during 1921 by two units, totalling 13,800 h.p., and another unit of 6,900 h.p. is now being installed. This will bring the total installation up to eleven units aggregating 67,100 h.p. A new duplicate transmission line to the city was also completed.

The development at Du Bonnet falls (Great Falls) on the Winnipeg river, commenced in 1919 but delayed by financial conditions, is now financed and under active construction. The undertaking is taken over from the Winnipeg River Power Company by the Manitoba Power Company, Limited. The initial installation will be two units totalling 56,000 h.p. and the ultimate, six units totalling 168,000 h.p., at a cost of about $10,000,000; the initial installation is expected to be completed in 1924.

The City of Winnipeg and District will then be well supplied with power from the three developments, i.e., the City's plant, 67,100 h.p., Winnipeg Electric Company's plant at Pinawa, 35,600 h.p., and the Du Bonnet plant 56,000 h.p. a total of 160,700 h.p.; in addition to which the developments at Point du Bois and Du Bonnet provide for the installation of further units totalling some 146,500 h.p. First class undeveloped sites on the Winnipeg river will provide for approximately a further 300,000 installed h.p., so that the total power available from this source is some 600,000 h.p.

The Manitoba Power Commission, a provincial organization on similar lines to the Hydro-Electric Power Commission of Ontario, has been active during the past year in extending its transmission system and has now a considerable network. The original line to Portage la Prairie, conveying energy purchased in bulk from the City of Winnipeg, has been duplicated and additional lines have been built to Morden, Carmen, Roland, Jordan, etc. Extensions of 150 miles are contemplated during 1922.

ONTARIO

Construction in the Province of Ontario during the past year has been very considerable. In the same period field investigations and activities leading to future construction have been extensive and there is good prospect of continued construction in the present year.

The Ontario Hydro Electric Power Commission has continued its activity. Pre-eminent in its construction work of 1921 has been the *Queenston-Chippawa* project involving an initial installation of five 60,000 h.p. units and an ultimate installation of 600,000 h.p. As is well known this development when completed will be the largest single hydro-electric plant in the world containing the highest powered units (60,000 h.p.) yet built and setting in several respects new high standards in hydraulic practice. During the month of December water was turned on in the power canal and the first unit placed in operation. The second unit is ready for practically immediate operation. At the *Cameron Falls* development on the Nipigon river for the supply of power to Fort William and Port Arthur, this being the second largest generating plant of the Commission, construction of the control dam was completed, thereby permitting the initial installation of 25,000 h.p. operating under the full projected head. Provision has been made at the Cameron Falls plant for at total installation of 75,000 h.p. Work on the 10,000 h.p. development at Ranney's Falls on the Trent river near Campbellford was continued throughout the year.

Private interests have also been active in hydro power construction. The Twin Falls plant, of the Abitibi Power and Paper Company with a capacity of 24,000 h.p. has been completed, while other new plants completed include the 5200 h.p. development of the Spanish River Pulp and Paper Company at Smoky Falls on the Sturgeon river and the 4,500 h.p. development of Canada Cottons, Limited, at Cornwall. Extensions to existing plants completed during the year include 7,200 h.p. at the plant of the Great Lakes Power Company at Sault Ste. Marie and 250 h.p. at the Lincoln Paper Mills plant at Merriton and an addition of 4,800 h.p. to the Kenora municipal plant is under construction.

The total turbine capacity installed in Ontario during 1921 amounted to 174,000 h.p. with provision made for extensive additions during the forthcoming year as market conditions demand.

Numerous water power projects are receiving consideration. These have in view additional power supply for the Porcupine mining district, the electrification of the T. & N.O. Railway, and various pulp and paper undertakings.

The proposals for the improvement of navigation and development of power on the St. Lawrence river have been far advanced during the past year. The Board of Engineers appointed by the International Joint Commission to examine the feasibility of the undertaking presented their report last July and this is understood to have been favourable from both the financial and engineering standpoints. In brief, this report suggested four

schemes and recommended a combination plan by which the waterway improvement and initial power development of 1,464,000 h.p. in the international section would cost $252,000,000 and estimated that the power development would pay for the entire project in a comparatively few years; the full potential power development is estimated at 4,100,000 h.p. which could be reached as the market for power developed. Alternative proposals have been submitted by the Hydro Electric Power Commission of Ontario, by Hugh L. Cooper & Co., of New York, and by the New York and Ontario Power Company. The Commission in a final report dated 19th December, 1921, approve of the feasibility and desirability of the general navigation and power scheme but recommend that the engineering details be first passed upon by a Joint Board of Engineers of the two Governments.

QUEBEC

The activities of the Hydraulic Service of the Department of Lands and Forests and of the Quebec Streams Commission acting for the provincial government, have proved a very real incentive to the increased utilization of the water power resources of the province. Most beneficial work has been done by the Streams Commission in the actual creation of storage reservoirs in several of the principal watersheds. This work has not only proved of great value to the companies developing power on the various rivers so regulated, but has also added considerably to the provincial revenues in that the cost is ultimately met by the companies benefited.

Recent operations of the Commission have included the letting of the contract for a storage dam on the Savana river, a tributary of the Ste. Anne de Beaupre. This will provide additional water for the operation of the Laurentian Power Company's development at St. Eereol.

Considerable activity took place in water power installation during the year 1921 throughout Quebec province. At Cedars, the Cedars Rapids Manufacturing and Power Company had under way the addition of two new units of 10,800 horse power each, bringing their total installation to 151,200 horse power. This Company is also constructing a new transmission line of steel-cored alumninum cable, strung on steel poles, to Montreal, a distance of about 30 miles. At Shawinigan Falls, the Shawinigan Water and Power Company were preparing so install a new unit in their number two power station of 42,000 horse power. At Grand Mere additional turbine equipment was installed by the Laurentide Power Company to the extent of 42,000 horse power. The City of Sherbrooke has reconstructed its hydro-electric plant at Weedon on the St. Francis river by increasing the head four feet and adding a new 1,700 horse power unit, bringing the total installation to 4,650 horse power. At Nicolet Falls on the Nicolet river the Lotbiniere Lumber Company placed in operation a new installation of 1,680 horse power. The Dominion Textile Company replaced their old turbines at Magog by a new installation of 3,000 horse power. At St. Raphael on the Riviere du Sud, La Corporation d'Energie de Montmagny placed in

operation a new hydro-electric installation of 3,600 horse power. Price Brothers & Co., Ltd., completed their hydro-electric development at Chute aux Galets on the Shipshaw river of 17,600 horse power, the power to be transmitted for use in their pulp and paper mills at Kenogami and Jonquiere.

The development work completed in the province of Quebec during 1921 totalled to 90,000 installed h.p., with 42,000 h.p. in process of installation.

A number of new water power developments were projected during the year.

NEW BRUNSWICK

In New Brunswick an active development policy is carried on by the province through the New Brunswick Electric Power Commission. Construction has proceeded on the development on the Musquash river, with an installation of 11,000 h.p. for the supply of the cities of St. John and Moncton, and it is expected that power will be available for delivery in the spring of 1922. Contracts are now being negotiated for the annual supply of 15,000,000 k.w.h. to St. John and 5,000,000 k.w.h. to Moncton.

The Bathurst Lumber Company has had under construction at Grand Falls on the Nepisiguit river a plant of 13,000 h.p. for the operation of their pulp and sawmills and the supply of all commercial needs of the district and the installation of 9,000 h.p. was completed during 1921. The New Brunswisk Electric Power Commission have arranged for the purchase of a block of power from the plant and have completed a 33,000 volt transmission line 40 miles long connecting this development with Newcastle and other communities in that district.

The Commission have in view a further development on the Lepreau river to supplement the supply to the cities of St. John, Moncton and districts, and a development on the Tetagouche river for the supply of the North Shore district.

NOVA SCOTIA

The Nova Scotia Power Commission, formed in 1919 under the "Power Commission Act" for the purpose of creating a complete electric power system for the province, has since pursued an enterprising development policy. The first provincial development, that at St. Margaret's Bay near Halifax, with an ultimate capacity of 15,000 h.p., is now ready to deliver some 6,600 h.p. (shortly to be increased to 10,800 h.p.) to Halifax as soon as the contract under negotiation with the city is completed. The reconstruction and enlargement of the 800 h.p. plant on Mushamush river for the supply of Mahone, Lunenburg, Riverport, etc., has been completed.

In addition to the above work of the Commission several industrial installations have been made by private concerns. The Yarmouth Light and Power Company have practically completed the rebuilding of their plant destroyed by fire and an additional 150 h.p. unit is being installed at Messrs. Wright & Jodfrey's plant on the Gaspereau river.

Detailed investigations have been continued for a development with an ultimate capacity of 30,000 h.p. at Sheet Harbour to supply New Glas-

gow, Stellarton, Trenton, etc., and for two developments of 7,500 h.p. and 1,200 h.p. at Bear River, to supply Digby and other towns and projected industries.

NEW DOMINION WATER POWER REGULATIONS

As the fruition of several years of study by the Dominion Water Power Branch of the water power laws and regulations of all the principal water power countries of the world, a new set of regulations for water powers of Western Canada under the jurisdiction of the Dominion Government was completed during the year, under clause 12 of the Dominion Water Power Act. These Regulations were approved by Order-in-Council and were published as a supplement to the Canada Gazette of Nov. 12, 1921.

INVESTIGATION

St. Lawrence River

Prominent in the investigatory work of the year there must be mentioned that with respect to the St. Lawrence river. That carried out by Messrs. Wooten & Bowden for the International Joint Commission has been mentioned but reference must also be made to the exhaustive work on this matter by the Hydro Electric Power Commission of Ontario, which started in 1913 and reached its fruition in 1921 by the presentation to the International Joint Commission of three complete alternative schemes for utilizing the full power of the St. Lawrence river.

Co-operativve Investigation.

The basic investigatory work regarding water power resources carried on by the Dominion Water Power Branch under co-operative agreements with the provinces of Nova Scotia, New Brunswick, Prince Edward Island, Ontario and British Columbia has proceeded with most satisfactory results, and close co-operation and interchange of information has been maintained with the province of Quebec. This co-operation results in better organization and increased uniformity in methods of investigation and especially in the steady growth of the completeness and effectiveness of the Inventory of water power and allied resources throughout the Dominion that is maintained by the Dominion Water Power Branch at Ottawa for the benefit of all interested in water power development.

Stream Measurement

In addition to special investigations of water power resources it is of interest to note that there are now some 570 stream measurement stations regularly maintained on the principal streams from coast to coast, either by the Dominion Water Power Branch or by co-operation between that Branch and the respective provinces; these figures do not include those separately maintained by the Province of Quebec.

In Quebec, the Quebec Streams Commission, which gives its special attention to matters of storage and flood prevention, has continued its highly successful work in the creation of the St. Maurice, St. Francois and Ste. Anne De Beaupre reservoivs by studies of the water power possibilities of the St. Maurice, Chamouchane and Peribonka rivers and the follow-

ing north shore tributaries of the St. Lawrence, Les Escaomains, Bersimis and Franquelin.

Mackenzie District

Some special investigations were also carried out in 1921 by the Dominion Water Power Branch on the Slave and Hay rivers, which are of interest as being the neighborhood of the route to the new oil fields at Fort Norman. On the power reach of the Slave river, some 20 miles long between Fitzgerald and Fort Smith, the power capacity is estimated at some 300,000 h.p. and on the Hay river there are two attractive sites estimated at a total of 30,000 h.p., in both cases under ordinary minimum flow conditions.

Relation of Water Power to Coal Consumption.

Evidence on the relation of water power to coal consumption was submitted by the Dominion Water Power Branch to the Special Committee of the House of Commons on the Future Fuel Supply of Canada, which sat during the Session of 1921.

It was shown that in Canada there is 194% more water power developed per capita than in the United States, and that, in spite of our much colder average climate, the consumption of coal per capita in the United States is greater than in Canada by 159% in industries, 150% in electric power plants and by 50% in the general average for all uses. At the then price of coal this 50% lower consumption per capita in Canada represents an annual sum of $146,500,000 that, but for this water power development, would have to be spent on importing coal. The water power now developed is 2,756,000 horse power and the capital invested therein is about $534,000,000 so that, from the national point of view, this annual saving represents a return of 27.5% on the investment that has secured it.

GENERAL SUMMARY

The more important items of this review of hydro-electric progress in Canada in 1921 may be summarized.

There has been added to the installed capacity of water power plants practically 300,000 h.p. The new installation in the individual provinces has been approximately: Nova Scotia 13,C00, New Brunswick 9,000, Quebec 90,000, Ontario 174,000 and Manitoba 14,000.

The Power Commissions of Nova Scotia and New Brunswick have successfully carried out the first provincial developments and are practically ready to deliver electrical energy to the principal cities.

In Ontario the Queenston-Chippawa plant of the Hydro-Electric Power Commission of Ontario has been placed in operation with two 60,000 h.p. units installed.

In Manitoba the Manitoba Power Commission has extended its activities and the Manitoba Power Company has under active construction an important development at Great Falls on the Winnipeg river with an ultimate capacity of 168,000 h.p.

The latest figures on the water power resources of the Dominion showing the available water power, the additional installations during the past year and the present total developed power are presented in the appended table.

It will be noted from this table that the developed water power in Canada now totals to 2,756,000 h.p. with considerable activity in the way of new extensions, new construction and projects.

The figures for available power are based upon rapids, falls and power sites of which definite or well established information is to hand. Many feasible power sites are scattered from coast to coast which have not yet been investigated and placed on record. The above figures may therefore be said to represent the minimum power possibilities of the Dominion. As illustrative of the conservative nature of these figures, attention might be called to the provinces of New Brunswick and Nova Scotia where detailed analyses have disclosed most advantageous reservoir facilities for regulating stream flow and where it is estimated that, after providing for the diversity factor between installed power and consumers demands, these two provinces possess within their respective borders, 200,000 and 300,000 commercial horse power.

DEVELOPED AND AVAILABLE WATER POWER IN CANADA.

PROVINCE	TURBINE INSTALLATION IN H. P.			AVAILABLE 24 HR. POWER AT 80% EFFICIENCY	
	On Jan. 1, 1921.	Installed during 1921	On Jan. 1, 1922.	At Ordinary Minimum Flow H. P.	Dependable for six months H. P.
1	4	5	6	2	3
British Columbia	305,115	200	305,315	1,931,142	5,103,460
Albera	33,187	.....	33,187	475,281	1,137,505
Saskatchewan	.....	.....	.....	513,481	1,087,756
Manitoba	83,447	13,800	97,247	3,270,491	5,769,444
Ontario	1,039,000	173,650*	1,212,650	4,950,300	6,808,190
Quebec	926,095	89,290	1,015,385	6,915,244	11,640,052
New Brunswick	21,180	9,000	30,180	50,406	120,807
Nova Scotia	34,073	12,875	46,948	20,751	128,264
Prince Edward Island	1,869	.....	1,869	3,000	5,270
Yukon and N.W. Ter.	13,199	.....	13,199	125,220	275,250
	2,457,165	298,815	2,755,980	18,255,316	32,075,998

* Includes two units in the Queenston Plant.

The Kitchener Electrical Exhibition

By V. S. McINTYRE,
Superintendent, The Kitchener Light Commissioners

MR. Geo. O. Phillip, commonly known to his associates, as "Pop," conceived the idea in 1920 to put on an Electrical Show in Kitchener in the same building that Hydro Power was officially turned on by the late Sir James P. Whitney and Sir Adam Beck, on Oct. 11th, 1910. It was originally his idea to open the show on Oct. 11th, 1920, exactly ten years after Hydro was first turned on. Through unforeseen circumstances, however, it was impossible to put on the Show until May 1st, 1922.

In February, 1922, advertisements, consisting of eight sheet posters were gotten out and placed in all the cities between Niagara Falls and Windsor. There were 60,000 stickers sent out on envelopes. 1,000 pennant stickers were put on automobiles and trucks running throughout Southern and Western Ontario. Mr. Phillip was also able to have the Government put on a special cancellation stamp for a period of sixty days. This stamp cancelled all letters leaving the City of Kitchener. In addition, 2,500 passes were issued to all electrical men in Ontario, passes being sent as far north as Sudbury.

During the week of the Exhibition, between 15,000 and 18,000 people passed through the Exhibition. There were 62 different exhibits, the total value of the goods displayed being $170,000.00. Another feature of the Exhibition was that there were no goods or anything whatever displayed which was not entirely electrical.

The Contractors and Dealers of Kitchener and Waterloo co-operated and erected one immense booth. All goods exhibited by them in this booth were demonstrated in other booths by the manufacturers of the particular appliance. Everything in the Exhibition was for sale and a small percentage of the revenue received from sales made by the Contractors and Dealers in the centre booth was taken to defray their expenses incurred in the Exhibition, it making no difference which Contractor sold the appliance. There was complete harmony between all contractors, local Commissions and manufacturers, during the whole Exhibition.

A wireless company had an exhibit and endeavoured to put on wireless concerts during the Exhibition, but due to the interference of static electricity caused by exhibits of violet-ray outfits and spark plug testers, the wireless concerts were not a complete success.

A seven piece orchestra was provided, which played continuously from 8 p.m. to 11 p.m., during each night of the Exhibition.

The Kitchener Electrical Exhibition

The electric exhibition was put on in the Arena Rink by the enterprising electrical men in the districts of the Twin Cities of Kitchener and Waterloo, from May 1st to the 6th, thereby making a special effort to bring conspicuously before the Public or such of them as could be reached by an exhibition, the now well recognized caption of "Do It Electrically"; and the men of this district have added to this by the expression, "The Power That Moves the World."

By referring to the cut accompanying this, it will be easily seen that all of the uses of electricity for the household and some of them for the factory were included in the exhibits. The manufacturers of the Province entered into the spirit of the exhibition whole heartedly, and in each and every case had their experienced attendants to explain in detail the equipment displayed.

Electrical cooking and kitchen equipment came in for serious attention by the visitors, as there is a great interest in the districts adjacent to Kitchener and Waterloo, as well as in the Twin Cities themselves, in electric cooking, and the use of smaller cooking devices as well as the range. Expressions from visitors showed that many of them who had formerly been using gas and other fuels have cut their costs in two, by "Doing It Electrically."

Laundry machinery of many kinds and forms were in evidence in the exhibits, the tendency being, however, to the metal tubs in the washing machines and to the reversible wringer,

in preference to the metal tub and the extractor. In addition to the washing and laundry machines for washing purposes, there were on display a number of electric ironers, of the revolving cylinder type, from the small machines which will take care of the ordinary household needs to the larger machines for the larger places.

Equipment for use on the dining room tables probably took second place to that of cooking in the matter of interest by the visitors. Toasters, table grills, coffee percolators and tea samovars, etc., were in many of the booths, in a number of various forms, and these of course attracted the lady visitors very much.

Electric heating devices were in evidence in many of the booths, and as the question of heating by ordinary methods has become a serious problem by reason of the rising price of fuels or the continued holding of high prices of fuels, many were interested in the different forms and kinds of devices for this work that were shown.

Electric fixtures, shades and fittings in various forms, some of them novel, were displayed, and in view of the fact that the display was made in May, and that many new households, according to tradition and practice, are set up in June, there was considerable interest in this particular kind of display.

The larger portion of the centre section of the rink was devoted to a combination display by the electrical contractors and dealers of the Twin Cities. This display covered in range practically all of the lines of electrical equipment for the equipping of a home or for the additions to already fairly well equipped homes. A centre piece consisting of a fire place of standard design, but made up in a novel way, using various colors of stone, made a most attractive centre around which to display the various equipment which was shown. The spirit of co-operation between the local contractors and dealers was certainly in evidence in the way they handled this booth, from the point of view of the motto which was displayed above the booth: "Do It Electrically."

While it would be impossible to make a display of each and every kind of all the equipment that is driven by electricity or used in connection with the uses of electricity, the exhibition, however, had practically all of the lines covered, consistent with the space available, covering the wiring and installing of the equipment necessary to make the distribution in the home, the aesthetic part of fixtures and fittings in kinds, designs and finishes, in varieties enough to please the most fastidious in the fitting of a modern home. As well as the equipping of the place, all of the lines of utensils and devices necessary to the care of a particular family were taken care of, from the equipping of a place from the point of view of cleanliness of the place itself, cleanliness of the apparel of the family, and comfort of the home, as well as the equipment for the preparing of foods for the taking care of the inner man. In addition to this, provision was made for the covering of the lines for taking care of the sick of the family, by elec-

Kitchener Contractor-Dealers' Booth

trical treatments and the entertaining of the family by the modern radio methods.

The following excerpts are from the Kitchener Daily Telegraph of May 2, 1922:

"The largest and most remarkable exhibition that has ever been held in Ontario," was the manner in which Sir Adam Beck described the Electrical Exhibition at the Auditorium, which he officially opened on Monday night. The Chairman of the Hydro Commission frankly admitted that he was agreeably surprised at the magnitude of the display, and he was not the only person who was surprised.

The large number of citizens who attended the exhibition on the first night shared with Sir Adam in the surprise at the large and varied display that has been gathered together through the enterprise of Mr. G. O. "Pop" Phillip, with the co-operation of the local electrical dealers.

WAS A REVELATION.

The exhibition proved to be nothing short of a revelation. The Auditorium was a scene of remarkable brilliancy when all the lights in the building and the booths were turned on. There were scores of various colored lights in all the booths, which added to the beauty of the scene. There are about seventy-five booths and over 1,000 different types of electrical appliances are on display. An estimate of the cost of the display was made by several experts last night, and they agreed that the value was not less than $170,000.

BAFFLES DESCRIPTION

A description of the various displays baffles description, but Sir

Adam summed it up in his own characteristic manner when he declared that it was impossible ten years ago to conceive of a display of electrical equipment such as was to be seen here, and it was just as impossible to predict what will be done by electricity ten years hence. It is a display that should be seen by every man, woman and child in Kitchener and Waterloo. There is everything known in the electrical world on display, with the exception of an electrical automobile, and there will be one on display before the week is out.

THE EXHIBITORS

Exhibitors at the Electrical Show are as follows: Ingersoll Iron and Machine Company, A. H. Winter Joyner Company, Canadian Shade Company (two booths), Robertson Manufacturing Company, Keatting Company, Square "D" Company, George P. Eaton, Robins and Myers, A. B. C. Washer Company, Marco Company, Canadian Ironing Company, Apex Sweeper, Elliott Machine Company, Marconi Company, Baetz Specialty Company (two booths), Onward Manufacturing Company, Renfrew Electrical Products Company, Easy Washer Company, Canadian Edison Appliance Company, Hydro-Electric Power Commission (four booths), McClary Manufacturing Company (two booths), Bluebird Washer, Charles Branston, Hoover Suction Sweeper, Beatty Bros., Hughson Nuelife Company, Cadillac Vacuum Company, Empire Brass Company, Coffield Washer Company, National Electrical Heater Company, Continental Electrical Company, Canadian Westinghouse Company, 1900 Washer Company, Twin City Signs, Thor Washer Company, Galt Electrical Company (two booths).

The above mentioned exhibitors have placed their displays around the inside of the Auditorium. Down the centre are the following: Moffatt Stoves (six booths), A. U. Berberich (confections and refreshments) and the Twin City Electrical dealers. The local dealers represented in the last section are the Waterloo Electrical Shop, C. F. Schmidt, Star Electrical Company, Mattell and Bierwagen, Ellis and Howard, Electrical Service Company and the Doerr Electrical Company.

THE LANGUAGE OF SCIENCE

Scientific reports do not often provide humorous reading, but the following comparison will show that this quality, even if unintentional, is not always lacking. Giambattista Porta, a Neapolitan philosopher, who died in 1615, was requested to report his views on the lodestone, which he did as follows:

"I think the lodestone is a mixture of stone and iron, as an iron stone or a stone of iron. Yet do not think the stone is so changed into iron as to lose its own nature nor that the iron is so drowned in the stone but it preserves itself; and whilst one labours to get the victory of the other the attraction is made by the combat between the them. In that body there is more of the stone than of iron, and therefore the iron, that it may not be subdued by the stone, desires the force

and company of iron; that not being able to resist alone, it may be able by more help to defend itself. For all creatures defend their being; wherefore that it may enjoy friendly help and not lose its own perfection it willingly draws iron to it, or iron willingly comes to that."

More than three hundred years later, that is, early last year, a University professor, giving evidence before a Parliamentary Committee on fuel supply, was reported as saying:—

"In the main it is correct, but not scientifically correct. My talk might be criticised, part of this, in the analysis of coal. In analysing coal, called proximate analysis, coal is generally analysed for moisture, volatile combustion, fixed carbon and ash. Now the moisture in this coal is not the moisture that would appear in a piece of coal, but it is contained in the coal. This moisture is driven off your coal in your analysis as practically boiling water. Volatile combustibles comprise various constituents. Your fixed carbon is the remaining carbon contained in the ash. Following that, we know that the general accepted classification of coal in the lowest form is lignite, next bituminous, and next, generally speaking, is an anthracite. The classification of coal is a very difficult subject, and everybody who knows anything about classification of coal has a different idea from another man, but, generally speaking, between lignite and bituminous the distinction is in the moisture content of your coal."

How delighted he must have been when he read this effusion. One cannot help wondering what he really did say!

(Signed) H. Williamson,
Member Faraday Society.

The Electrical Review, March 24, 1922.

The Fourteenth Annual Report

The Fourteenth Annual Report of the Hydro-Electrical Power Commission has been completed and is now in the hands of the printers, but as it will in all probability be several months before it will be finally released, the readers of the Bulletin will note with interest a summary of the operation of each system and of the individual municipalities embraced therein in the familiar form known as statement "B" in the Annual Report.

Everyone connected with Hydro understands by this time that the Hydro-Electric Power Commission has no Profit and Loss Account, but the apparent deficits and surpluses indicated in its operating report are passed on to the municipalities and incorporated in their cost of power, so that the summary of municipal operation is the real measure of the success or failure of the general scheme of co-operative development, transmis-

sion and distribution of electrical energy at cost under the Power Commission Act.

The 1921 Report shows the result of operation in 205 municipalities in ten separate and distinct systems. As usual the Niagara System stands in a class by itself due to the relatively low price of power and the large industrial loads, giving the maximum benefits of loaded transmission lines and transformer stations. Out of a total of 131 municipalities embraced in this system, there were but seven showing an actual money loss, amounting to a total of $1,675.87, while the total gross surplus on the balance amounted to $1,474,738.66 and there were but fifteen municipalities on this system which failed to provide a full theoretical depreciation out of their revenue. Considering the fact that rates are set in advance for the entire year and successful operation is so largely dependent on steady loads and diversity, the result is not only gratifying but may well be regarded as phenomenal.

The operation of the smaller systems may as a whole be considered quite as satisfactory as that of the Niagara. A larger percentage of the municipalities failed to provide a gross and net surplus, but considering the character of the districts served, the smaller size of the municipalities and their comparative isolation requiring long stretches of transmission line with small loads, it would be unfair to expect them to measure up to the results shown in the industrial area served by the Niagara System. However, out of a total of 74 municipalities served by 9 different systems, there were but 25 which showed a gross loss, this list being largely made up by the new municipalities connected to the Eugenia and St. Lawrence Systems during the year where the operation covered but a few months and where the revenue was far below normal. While these gross deficits totalled $39,604.77, the rest of the municipalities in these systems accumulated a gross surplus of $235,765.39, so that collectively, the year's operations show a gross surplus of $196,160.62.

The summary will show that out of a total of 205 municipalities, there were 32 which failed to meet all of their operating expenses, including debenture charges and the full cost of power, and there were in all 51 which failed to provide full theoretical depreciation. However, the summary also shows a net surplus of $625,602.26 after providing for depreciation to the extent of $1,043,620.85, which should measure up to the expectations of even the most enthusiastic friends of Hydro.

REPORT SHOWING OPERATION OF MUNICIPALITIES
NIAGARA

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Acton	$ 7,219 94	$ 3,073 06	$ 491 90	$ 10,784 90	$ 13,062 32
Ailsa Craig	5,744 46	264 71	397 73	6,406 90	8,298 26
Ancaster Twp	2,719 89	2,142 68	1,649 87	6,512 44	9,196 12
Aylmer	8,262 56	3,732 82	2,284 44	14,279 82	20,360 30
Ayr	3,304 43	831 34	1,025 16	5,160 93	6,898 08
Baden	5,974 22	967 02	116 75	7,057 99	8,003 55
Beachville	8,517 36	758 62	124 21	9,400 19	9,893 36
Blenheim	7,343 51	3,031 07	1,069 93	11,444 51	14,065 66
Bolton	5,945 83	1,613 00	1,387 13	8,945 96	9,081 39
Bothwell	7,031 51	887 00	1,208 32	9,126 83	11,635 02
Brampton	21,166 54	5,694 03	3,268 04	30,128 61	35,576 53
Brantford	92,629 23	44,046 48	22,499 48	159,175 19	175,465 27
Brantford Twp	5,957 15	3,795 73	4,366 51	14,119 39	16,495 77
Brigden	4,925 99	762 97	915 50	6,604 46	7,543 77
Burford	3,386 56	502 77	496 42	4,385 75	5,391 51
Burgessville	1,232 15	105 38	277 63	1,615 16	2,246 43
Caledonia	2,180 89	686 68	346 41	3,213 98	4,728 80
Chatham	67,580 08	47,560 78	21,050 52	136,191 38	167,429 96
Chippawa	1,481 67	1,262 62	954 68	3,698 97	4,808 07
Clinton	7,224 64	2,304 93	3,016 69	12,546 26	16,198 87
Comber	5,312 48	662 08	824 38	6,798 94	8,734 62
Dashwood	3,126 68	305 90	217 21	3,649 79	3,439 43
Delaware	857 64	141 03	233 03	1,231 70	1,706 26
Dereham Twp	3,096 88	1,364 10	3,413 75	7,874 73	7,785 76
Dorchester	1,247 24	567 26	245 11	2,059 61	3,022 54
Drayton	3,400 14	341 07	674 75	4,415 96	5,566 82
Dresden	6,237 28	2,298 27	1,252 35	9,787 90	13,688 46
Drumbo	1,080 01	210 08	257 84	1,547 93	2,385 06
Dublin	2,169 97	445 05	593 37	3,208 39	2,938 25
Dundas	20,937 71	10,827 99	3,394 82	35,160 52	42,966 07
Dunnville	10,918 66	4,020 11	5,100 01	20,038 78	21,806 74
Dutton	4,278 18	1,317 74	445 43	6,041 35	7,213 64
Elmira	10,187 41	3,441 57	1,416 58	15,045 56	19,179 92
Elora	7,947 21	2,817 81	974 55	11,739 57	12,681 28
Embro	3,276 11	337 84	723 58	4,337 53	5,523 46
Etobicoke Twp	8,382 37	4,978 13	7,526 89	20,887 39	33,005 12
Exeter	8,531 44	2,056 32	1,199 15	11,786 91	14,487 44
Fergus	7,619 95	3,455 64	1,720 92	12,796 51	14,134 38
Forest	6,779 33	3,333 50	2,737 43	12,850 26	15,998 46
Galt	64,467 06	23,967 85	16,506 46	104,941 37	131,536 15

FOR PERIOD ENDING DECEMBER 31st. 1921
SYSTEM

Gross Surplus	Gross Deficit	Depreciation	Net Surplus	Net Deficit	Population
$ 2,277 42	$............	$ 916 00	$ 1,361 42	$............	1,594
1,891 36	....	479 00	1,412 36	....	535
2,683 68	....	1,146 00	1,537 68	....	....
6,080 48	....	1,087 00	4,993 48	....	2,241
1,737 15	....	540 00	1,197 15	....	796
945 56	....	438 00	507 56	....	....
493 17	....	543 00	....	49 83	....
2,621 15	....	1,097 00	1,524 15	....	1,528
135 43	....	938 00	....	802 57	656
2,508 19	....	308 00	2,200 19	....	630
5,447 92	....	4,156 00	1,291 92	....	4,406
16,290 08	....	15,444 35	845 73	....	32,786
2,376 38	....	1,999 00	377 38	....	....
939 31	....	391 00	548 31	....	....
1,005 76	....	350 00	655 76	....	....
631 27	....	182 00	449 27	....	....
1,514 82	....	487 00	1,027 82	....	1,308
31,238 58	....	10,050 00	21,188 58	....	15,525
1,109 10	....	632 00	477 10	....	1,099
3,652 61	....	1,490 00	2,162 61	....	1,838
1,935 68	....	368 00	1,567 68	....	....
....	210 36	172 00	....	382 36	....
474 56	....	141 00	333 56	....	....
....	88 97	2,195 00	....	2,283 97	....
962 93	....	306 00	656 93	....	....
1,150 86	....	422 00	728 86	....	602
3 900 56	....	796 00	3,104 56	....	1,393
837 13	....	203 00	634 13	....	....
....	270 14	253 00	....	523 14	....
7,805 55	....	4,400 00	3,405 55	....	5,054
1,767 96	....	2,641 00	....	873 04	3,569
1,172 29	....	530 00	642 29	....	870
4,134 36	....	1,417 00	2,717 36	....	2,400
941 71	....	937 00	4 71	....	1,199
1,185 93	....	408 00	777 93	....	463
12,117 73	....	5 380 00	6,737 73	....	....
2,700 53	....	959 00	1,741 53	....	1 458
1,337 87	....	1,285 00	52 87	....	1,815
3,148 20	....	1,171 00	1,977 20	....	1,386
26,594 78	....	13,282 16	13,312 62	....	13 092

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Georgetown	$ 21,458 22	$ 4,027 10	$ 1,096 73	$ 26,582 05	$ 28,805 39
Glencoe	5,084 48	828 49	2,629 70	8,542 67	10,909 43
Goderich	21,554 59	8,682 71	4,603 54	34,840 84	39,167 77
Grantham Twp	1,405 83	1,406 53	3,073 36	5,885 72	7,852 83
Granton	2,242 62	192 42	271 59	2,706 63	3,821 17
Guelph	84,268 29	34,233 26	8,478 38	126,979 93	144,771 70
Hagersville	11,754 85	2,152 96	413 74	14,321 55	18,044 35
Hamilton	304,139 38	160,206 24	83,014 98	547,360 60	608,687 15
Harriston	8,314 86	2,040 60	1,393 89	11,749 35	15,152 88
Hensall	3,079 13	801 59	840 77	4,721 49	5,562 33
Hespeler	9,841 93	6,102 48	2,183 43	18,127 84	18,590 92
Highgate	2,080 99	422 71	325 26	2,828 96	3,931 97
Ingersoll	25,721 93	11,778 26	3,479 14	40,979 33	46,033 30
Kitchener	137,226 38	47,036 30	17,083 25	201,345 93	224,332 76
Lambeth	1,341 93	368 44	309 22	2,019 59	2,856 62
Listowel	15,222 99	5,879 93	3,779 12	24,882 04	29,374 14
London	291,370 63	165,428 08	73,685 48	530,484 19	589,889 62
Louth Twp		597 53	494 41	1,091 94	728 10
Lucan	6,424 35	1,524 76	641 99	8,591 10	11,763 01
Lynden	4,362 89	197 82	342 76	4,903 47	5,700 35
Markham	3,139 96	1,667 73	1,296 37	6,104 06	9,249 11
Merritton	3,052 27	5,568 15	746 89	9,367 31	12,653 09
Milton	18,846 46	2,586 52	1,386 63	22,819 61	26,714 19
Milverton	8,748 51	1,306 87	601 01	10,656 39	13,002 77
Mimico	9,185 53	6,256 79	2,092 73	17,535 05	21,087 64
Mitchell	6,060 55	2,736 61	1,759 54	10,556 70	15,996 18
Moorefield	1,868 94	196 74	383 48	2,449 16	2,937 93
Mount Brydges	1,863 09	316 20	247 55	2,426 84	3,224 15
Newbury	863 59	85 72	655 07	1,604 38	1,800 72
New Hamburg	7,644 94	3,151 19	1,119 52	11,915 65	13,478 44
New Toronto	68,979,18	8,477 68	169 43	77,626 29	78,841 50
Niagara-on-the-Lake	3,407 88	3,831 33	1,518 51	8,757 72	14,482 64
Niagara Falls	50,073 13	42,974 33	17,714 39	110,761 85	127,634 38
Norwich	4,347 63	12,972 54	643 70	17,963 87	22,514 67
Oil Springs	5,245 21	867 95	940 99	7,054 15	9,040 83
Otterville	1,661 26	353 01	303 44	2,317 71	3,907 78
Palmerston	6,845 88	1,833 93	2,018 00	10,697 81	17,505 95
Paris	15,186 57	6,653 54	6,396 05	28,236 16	35,261 23
Parkhill	3,735 92	615 79	1,472 10	5,823 81	8,969 59
Petrolia	18,139 05	7,549 84	3,768 36	29,457 25	39,856 98

Gross Surplus	Gross Deficit	Depreciation	Net Surplus	Net Deficit	Population
2,223 34	$	$ 2,179 00	$ 44 34	$	2,554
2,366 76		806 00	1,560 76		779
4,326 93		4,260 00	66 93		4,287
1,967 11		475 40	1,491 71		
1,114 54		217 00	897 54		
17,791 77		12,466 00	5,325 77		17,922
3,722 80		708 00	3,014 80		1,139
61,326 55		61,173 28	153 27		114,766
3,403 53		783 00	2,620 53		1,326
840 84		524 00	316 84		687
463 08		2,088 00		1,624 92	3,059
1,103 01		289 00	814 01		403
5,053 97		3,995 00	1,058 97		5,422
22,986 83		19,567 00	3,419 83		23,027
837 03		216 00	621 03		
4,492 10		2,043 00	2,449 10		2,571
59,405 43		58,898 95	506 48		59,281
	363 84	70 00		433 84	
3,171 91		614 00	2,557 91		614
796 88		228 00	568 88		
3,145 05		755 00	2,390 05		941
3,285 78		948 00	2,337 78		2,480
3,894 58		1,496 00	2,398 58		1,800
2,346 38		628 00	1,718 38		1,029
3,552 59		2,461 00	1,091 59		4,187
5,439 48		2,069 00	3,370 48		1,686
488 77		187 00	301 77		
797 31		222 00	575 31		
196 34			196 34		283
1,562 79		1,306 00	256 79		1,401
1,215 21		2,354 00		1,138 79	2,850
5,724 92		708 00	5,016 92		1,863
16,872 53		12,539 50	4,333 03		14,805
4,550 80		2,970 00	1,580 80		1,237
1,986 68		1,628 00	1,358 68		443
1,590 07		286 00	1,304 07		
6,808 14		1,015 00	5,793 14		1,850
7,025 07		4,178 00	2,847 07		4,346
3,145 78		670 00	2,475 78		1,194
10,399 73		2,808 00	7,591 73		2,964

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Plattsville	$ 2,394 50	$ 350 39	$ 316 87	$ 3,061 76	$ 2,633 73
Port Colborne	6,724 89	4,736 31	3,592 87	15,054 07	20,281 45
Port Credit	3,348 13	1,453 02	479 69	5,280 84	7,993 97
Port Dalhousie	2,908 23	3,338 29	1,139 88	7,386 40	8,649 46
Port Dover	....	....	....	....	....
Port Stanley	8,105 86	3,833 37	1,039 71	12,978 94	15,240 58
Preston	35,661 24	15,978 96	7,352 15	58,992 35	58,916 60
Princeton	1,543 22	203 93	249 98	1,997 13	2,016 78
Queenston	413 07	238 65	172 20	823 92	1,398 55
Ridgetown	8,006 37	3,022 69	1,374 44	12,403 50	17,338 96
Rockwood	2,982 79	454 71	342 65	3,780 15	5,148 30
Rodney	2,522 47	700 63	531 12	3,754 22	6,033 49
Sarnia	86,888 58	37,032 64	24,544 17	148,465 39	197,578 81
Scarboro Twp	5,749 72	4,620 72	5,845 73	16,216 17	20,774 16
Seaforth	13,632 26	3,003 42	1,052 61	17,688 29	21,384 39
Simcoe	7,775 63	2,889 50	1,318 11	11,983 24	15,810 25
Springfield	1,908 46	358 24	718 26	2,984 96	3,058 26
St. Catharines	49,991 59	43,797 79	18,967 83	112,757 21	137,525 60
St. George	3,025 92	575 53	220 37	3,821 82	4,583 30
St. Jacobs	2,775 48	401 59	365 30	3,542 37	4,329 57
St. Marys	28,024 07	6,723 30	3,719 89	38,467 26	45,965 99
St. Thomas	62,070 55	34,560 89	5,478 79	102,110 23	131,001 36
Stamford Twp	6,834 11	5,385 91	4,481 41	16,701 43	19,026 34
Stratford	60,191 16	27,041 64	14,403 38	101,636 18	121,334 39
Strathroy	14,031 07	6,106 01	3,409 14	23,546 22	29,922 58
Tavistock	8,885 93	983 39	109 77	9,979 09	13,321 24
Thamesford	4,622 18	437 43	470 86	5,530 47	6,684 13
Thamesville	3,719 25	741 39	829 95	5,290 59	9,299 73
Thorndale	3,890 74	293 81	305 84	4,490 39	4,251 61
Thorold	7,050 39	7,606 94	....	14,657 33	19,501 58
Tilbury	6,101 98	1,903 86	1,231 85	9,237 69	12,447 90
Tillsonburg	13,359 45	6,000 22	2,254 66	21,614 33	26,875 09
Toronto	1,111,019 01	1,172,880 41	658,698 90	2,942,598 32	3,593,118 05
Toronto Twp	6,629 82	3,097 68	4,351 27	14,078 77	25,042 87
Vaughan Twp	1,775 52	374 70	2,586 40	4,736 62	5,196 39
Walkerville	118,454 99	42,808 21	16,330 02	177,593 22	205,841 71
Wallaceburg	21,486 10	9,230 00	4,558 78	35,274 88	48,213 54
Wardsville	321 84	52 89	65 03	439 76	862 21
Waterdown	3,971 59	1,072 38	1,336 98	6,380 95	8,501 55
Waterford	4,374 55	1,961 95	1,285 86	7,622 36	8,897 68

Gross Surplus	Gross Deficit	Depreciation	Net Surplus	Net Deficit	Population
$....	$ 428 03	$ 244 00	$....	$ 672 03	....
5,227 38	....	1,892 00	3,335 38	....	2,956
2,713 13	....	765 94	1,947 19	....	1,044
1,263 06	....	649 00	614 06	....	1,565
....	....	....	....	....	....
2,261 64	....	1,157 00	1,104 64	....	797
....	75 75	5,452 00	....	5,527 75	5,355
19 65	....	144 00	....	124 35	....
574 63	....	....	574 63	....	....
4,935 46	....	1,043 00	3,892 46	....	2,256
1,368 15	....	410 00	958 15	....	....
2,279 27	....	434 00	1,845 27	....	676
49,113 42	....	12,937 00	36,176 42	....	13,870
4,557 99	....	2,995 00	1,562 99	....	....
3,696 10	....	2,178 00	1,518 10	....	1,981
3,827 01	....	1,824 00	2,003 01	....	3,946
73 30	....	....	73 30	....	470
24,768 39	....	14,403 50	10,364 89	....	19,862
761 48	....	281 00	480 48	....	....
787 20	....	256 00	531 20	....	....
7,498 73	....	4,264 12	3,234 61	....	4,004
28,891 13	....	12,282 00	16,609 13	....	17,850
2,324 91	....	2,237 00	87 91	....	....
19,698 21	....	14,275 00	5,423 21	....	18,871
6,376 36	....	2,500 00	3,876 36	....	2,654
3,342 15	....	515 00	2,827 15	....	1,003
1,153 66	....	382 00	771 66	....	....
4,009 14	....	572 00	3,437 14	....	....
....	238 78	197 00	....	435 78	....
4,844 25	....	2,379 00	2,465 25	....	5,514
3,210 21	....	609 00	2,601 21	....	1,749
5,260 76	....	3,008 00	2,252 76	....	3,021
650,519 73	....	430,352 42	220,167 31	....	512,812
10,964 10	....	4,419 00	6,545 10	....	....
459 77	....	1,234 00	....	774 23	....
28,248 49	....	11,946 44	16,302 05	....	7,469
12,938 66	....	2,784 00	10,154 66	....	4,119
422 45	....	....	422 45	....	215
2,120 60	....	1,306 00	814 60	....	816
1,275 32	....	592 00	683 32	....	1,083

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Waterloo	$ 29,065 23	$ 13,674 48	$ 7,387 62	$ 50,127 33	$ 56,496 23
Watford	5,456 37	1,444 31	935 04	7,835 72	9,949 98
Welland	33,834 50	21,038 83	16,818 66	71,691 99	82,865 59
West Lorne	5,584 68	869 53	507 95	6,962 16	10,374 76
Wellesley	4,698 61	772 95	569 31	6,040 87	6,378 43
Weston	22,696 37	6,425 19	1,243 77	30,365 33	3,068 53
Windsor	203,714 88	173,700 71	51,931 34	429,346 93	513,863 66
Woodbridge	3,802 81	699 81	417 01	4,919 63	6,445 04
Woodstock	40,036 09	16,242 68	4,439 44	60,718 21	77,893 78
Wyoming	2,091 69	643 12	921 69	3,656 50	4,484 65
Zurich	4,001 87	420 93	232 83	4,655 63	5,281 96
Total	3,733,629 99	2,447,009 63	1,250,716 81	7,431,356 43	8,904,419 22

SEVERN

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Alliston	8,947 66	2,028 92	3,643 78	14,620 36	14,194 32
Barrie	27,450 40	7,868 40	3,476 93	38,795 73	44,921 13
Beeton	7,233 30	467 62	1,233 85	8,934 77	8,742 78
Bradford	6,054 39	775 71	1,722 04	8,552 14	7,136 53
Coldwater	3,087 48	697 17	600 17	4,384 82	5,707 69
Collingwood	44,861 16	7,267 35	2,085 46	54,213 97	47,485 82
Cookstown	3,317 25	611 94	1,026 08	4,955 27	5,516 61
Creemore	3,494 32	426 60	492 69	4,413 61	5,738 31
Elmvale	5,730 10	825 74	418 25	6,974 09	7,987 92
Midland	33,310 92	8,498 52	7,197 90	49,007 34	56,096 02
Penetang	22,367 18	4,580 98	2,483 70	29,431 86	32,744 63
Port McNichol	1,541 88	416 91	793 81	2,752 60	3,251 52
Stayner	5,307 43	858 88	1,177 64	7,343 95	8,850 53
Thornton	1,420 00	132 86	676 49	2,229 35	1,571 94
Tottenham	4,183 18	552 03	1,300 62	6,035 83	4,763 00
Victoria Harbor	2,120 97	843 33	525 58	3,489 88	3,880 94
Waubaushene	1,256 89	340 31	305 58	1,902 78	2,437 21
Total	181,684 51	37,193 27	29,160 57	248,038 35	261,026 90

EUGENIA

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Arthur	10,829 32	937 72	2,130 14	13,897 18	11,399 87
Chatsworth	1,766 98	414 44	560 23	2,741 65	2,839 40
Chesley	11,744 97	1,484 42	2,653 20	15,882 59	18,171 08
Dundalk	4,575 06	428 90	515 78	5,519 74	6,758 65
Durham	10,358 25	1,903 94	1,846 06	14,108 25	17,149 96

Gross Surplus	Gross Deficit	Depreciation	Net Surplus	Net Deficit	Population
$ 6,368 90	$	$ 7,176 87	$	$ 807 97	5,744
2,114 26	....	575 00	1,539 26	....	1,033
11,173 60	....	8,555 00	2,618 60	....	9,356
3,412 60	....	474 00	2,938 60	....	770
337 56	....	330 00	7 56	....	....
5,703 20	....	3,812 00	1,891 20	....	3,104
84,516 73	....	23,440 00	61,076 73	....	37,120
1,525 41	....	598 00	927 41	....	661
17,175 57	....	8,752 00	8,423 57	....	10,333
828 15	....	400 00	428 15	....	475
626 33	....	276 00	350 33	....	....
1,474,738 66	1,675 87	887,076 93	602,440 43	16,454 57	1,105,493

SYSTEM

....	426 04	1,364 00	....	1,790 04	1,301
6,125 40	....	4,486 00	1,639 40	....	6,876
....	191 99	604 00	....	795 99	580
....	1,415 61	765 00	....	2,180 61	907
1,322 87	....	518 00	804 87	....	663
....	6,728 15	3,924 00	....	10,652 15	6,016
561 34	....	517 00	44 34	....	....
1,324 70	....	387 00	937 70	....	603
1,013 83	....	547 00	466 83	....	....
7,088 68	....	5,664 00	1,424 68	....	7,129
3,312 77	....	2,968 00	344 77	....	3,896
498 92	....	340 00	158 92	....	614
1,506 58	....	686 00	820 58	....	927
....	657 41	312 00	....	969 41	....
....	1,272 83	437 00	....	1,709 83	452
391 06	....	352 00	39 06	....	1,462
534 43	....	202 00	332 43	....	....
23,680 58	10,692 03	24,073 00	7,013 58	18,098 03	33,426

SYSTEM

....	2,497 31	979 00	....	3,476 31	1,218
97 75	....	233 00	....	135 25	326
2,288 49	....	1,189 00	1,099 49	....	1,721
1,238 91	....	404 00	834 91	....	690
3,041 71	....	1,071 00	1,970 71	....	1,400

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Elmwood	$ 2,650 67	$ 161 43	$ 691 15	$ 3,503 25	$ 3,659 01
Flesherton	2,765 44	512 25	604 17	3,881 86	3,954 00
Grand Valley	3,883 65	422 39	1,032 14	5,338 18	7,213 20
Hanover	39,888 41	5,893 97	6,302 01	52,084 39	55,983 02
Holstein	1,788 06	154 69	422 15	2,364 90	1,495 10
Kincardine	7,061 19	4,587 23	3,415 75	15,064 17	8,824 70
Lucknow	4,454 69	332 84	1,077 16	5,864 69	5,316 67
Markdale	3,232 18	842 45	916 69	4,991 32	6,550 85
Mount Forest	12,830 19	2,904 90	2,402 25	18,137 34	16,959 97
Neustadt	7,107 25	562 49	1,333 22	9,002 96	6,086 75
Orangeville	9,319 36	2,321 53	3,104 75	14,745 64	15,583 37
Owen Sound	56,720 95	21,800 30	9,628 36	88,149 61	83,340 77
Priceville	507 72	17 60	348 72	874 04	644 30
Ripley	4,354 38	261 41	745 23	5,361 02	5,103 30
Shelburne	7,945 42	843 82	1,932 79	10,722 03	12,404 42
Tara	4,333 05	726 22	1,566 46	6,625 73	6,183 78
Teeswater	4,598 73	357 86	3,148 82	8,105 41	5,580 79
Wingham	19,544 70	7,022 36	4,234 35	30,801 41	32,523 38
Total	232,260 62	54,895 16	50,611 58	337,767 36	333,726 34

WASDELL'S

Beaverton	5,630 75	1,301 34	1,610 05	8,542 14	12,335 66
Brechin	3,268 69	354 19	396 45	4,019 33	4,055 90
Cannington	4,112 90	1,032 18	1,261 26	6,406 34	9,344 88
Kirkfield	1,010 96	248 10	544 58	1,803 64	1,657 81
Sunderland	3,607 33	701 82	1,238 82	5,547 97	6,265 67
Woodville	3,955 25	668 02	791 37	5,414 64	6,518 48
Total	21,585 88	4,305 65	5,842 53	31,734 06	40,178 40

MUSKOKA

Gravenhurst	6,807 01	4,769 58	3,818 56	15,395 15	17,791 74
Huntsville	20,362 63	3,181 63	2,301 81	25,846 07	29,553 61
Total	27,169 64	7,951 21	6,120 37	41,241 22	47,345 35

ST. LAWRENCE

Alexandria	10,316 44	3,241 87	2,504 84	16,063 15	13,939 29
Apple Hill	825 96	190 69	29 40	1,046 05	993 54
Brockville	55,951 02	28,648 24	18,647 80	103,247 06	105,605 64
Chesterville	11,671 99	1,530 56	940 99	14,143 54	13,850 57
Lancaster	2,232 53	101 74	618 51	2,952 78	1,426 55

Gross Surplus	Gross Deficit	Depreciation	Net Surplus	Net Deficit	Population
$ 155 76	$	$ 272 00	$	$ 116 24	
72 14		309 00		236 86	417
1,875 02		515 00	1,360 02		595
3,898 63		3,056 00	842 63		2,842
	869 80	124 00		993 80	
	6,239 47			6,239 47	2,036
	548 02			548 02	918
1,559 53		600 00	959 53		927
	1,177 37	1,203 00		2,380 37	1,825
	2,916 21	611 00		3,527 21	444
837 73		1,497 00		659 27	2,427
	4,808 84	6,392 67		11,201 51	12,013
	229 74			229 74	
	257 72			257 72	
1,682 39		886 00	796 39		1,075
	441 95	576 00		1,017 95	537
	2,524 62			2,524 62	807
1,721 97		2,660 00		938 03	2,337
18,470 03	22,511 05	22,577 67	7,863 68	34,482 37	36,555

SYSTEM

3,793 52		621 00	3,172 52		975
36 57		134 00		97 43	
2,938 54		578 00	2,360 54		896
	145 83	249 00		394 83	
717 70		260 00	457 70		
1,103 84		192 00	911 84		448
8,590 17	145 83	2,034 00	6,902 60	492 26	3,819

SYSTEM

2,396 59		2,135 00	261 59		1,432
3,707 54		966 00	2,741 54		2,176
6,104 13		3,101 00	3,003 13		3,608

SYSTEM

	2,123 86			2 123 86	2,274
	52 51			52 51	
2,358 58		4,867 00		2,508 42	9,254
	292 97	534 00		826 97	919
	1,526 23			1,526 23	639

Municipality	Power Purchased	Operation and Maintenance	Debenture Charges and Interest	Total Operation	Revenues
Martintown	$ 531 71	$ 33 81	$ 232 21	$ 797 73	$ 712 82
Maxville	3,735 26	441 76	1,007 25	5,184 27	3,265 31
Prescott	10,946 18	5,537 88	2,200 91	18,684 97	23,075 74
Williamsburg	1,333 75	304 50	220 67	1,858 92	1,900 03
Winchester	6,057 65	1,707 43	907 59	8,672 67	11,215 66
Total	103,602 49	41,738 48	27,310 17	172,651 14	175,985 15

RIDEAU

Carlton Place	31,698 59	6,931 86	4,200 20	42,830 65	42,574 23
Lanark	556 24	42 98	65 47	664 69	755 81
Perth	22,699 64	5,177 83	6,218 98	34,096 45	42,043 62
Smith's Falls	33,638 60	14,165 49	16,858 51	64,662 60	67,021 38
Total	88,593 07	26,318 16	27,343 16	142,254 39	152,395 07

THUNDER BAY

Port Arthur	180,592 95	65,849 72	39,666 65	286,109 32	319,029 63

OTTAWA

Ottawa	107,133 65	114,058 64	45,124 72	266,317 01	328,108 97

TRENT

Bloomfield	2,341 71	359 47	918 09	3,619 27	3,757 60
Havelock	2,918 77	902 81	1,821 09	5,642 67	5,955 15
Kingston	55,636 24	55,113 83	22,248 07	132,998 14	160,520 53
Lakefield	4,984 23	1,502 29	2,330 62	8,817 14	9,316 51
Marmora	1,227 59	495 66	1,755 08	3,478 33	5,047 55
Norwood	1,104 30	997 46	736 25	2,838 01	4,641 03
Omemee	2,044 94	398 12	1,169 49	3,612 55	4,922 99
Peterboro	106,360 28	49,800 99	16,285 32	172,446 59	186,457 35
Picton	14,126 15	6,508 22	451 28	21,085 65	37,678 90
Wellington	3,389 36	1,200 43	1,121 47	5,711 26	6,429 66
Total	194,133 57	117,279 28	48,836 76	360,249 61	424,727 27
Total—All Systems	4,870,386 37	2,916,599 20	1,530,733 32	9,317,718 89	10986942 30

Gross Surplus	Gross Deficit	Depreciation	Net Surplus	Net Deficit	Population
$............	$ 84 91	$............	$............	$ 84 91	....
....	1,918 96	....	....	1,918 96	721
4,390 77	....	2,422 00	1,968 77	....	2 758
41 11	....	124 00	....	82 89	....
2,542 99	....	579 00	1,963 99	....	1,028
9,333 45	5,999 44	8,526 00	3,932 76	9,124 75	19,093

SYSTEM

....	256 42	2,231 00	....	2 487 42	3,430
91 15	....	....	91 15	....	625
7 947 17	....	2,725 00	5,222 17	....	3,630
2,358 78	....	6,639 25	....	4,280 47	6,665
10,397 10	256 42	11,595 25	5,313 32	6,767 89	14,350

SYSTEM

32,920 31	....	11,492 00	21,428 31	....	15,201

SYSTEM

61,791 96	....	46,737 00	15,054 96	....	110,708

SYSTEM

138 33	....	386 00	....	247 67	550
312 48	....	....	312 48	....	1,266
27,522 39	....	12,603 00	14,919 39	....	22,368
499 37	....	901 00	....	401 63	1,146
1,569 22	....	....	1,569 22	....	853
1,803 02	....	....	1,803 02	....	711
1,310 44	....	529 00	781 44	....	557
14,010 76	....	10,419 00	3,591 76	....	21,790
16,593 25	....	955 00	15,638 25	....	3,189
718 40	....	615 00	103 40	....	850
64,477 66	....	26,408 00	38,718 96	649 30	53,280
1,710,504 05	41,280 64	1,043,620 85	711,671 73	86,069 17	1,395,533

Excitation and Relay Systems at Queenston Generating Station

By E. M. WOOD
Assistant Engineer, H.E.P.C. of Ontario

IN any power station, the quality of the service which can be given depends to a very considerable extent on proper provision for excitation of the generators and on a good system of protective relays. These features were given careful attention in laying out the Queenston generating station, and a description of these systems may be of interest to the readers of the Bulletin.

EXCITATION

The principal source of excitation for each unit is the direct connected exciter mounted above the generator. Each exciter has sufficient capacity to furnish excitation for one 45,000 k.v.-a generator, and is rated at 150 k.w. 250 volts. It is of the shunt wound type with commutating poles and is especially designed for service with a generator voltage regulator.

The auxiliary source of excitation consists of a motor-generator set consisting of a 250 volt 150 k.w. shunt wound D.C. generator, with commutating poles designed to carry the excitation of any one of the generators, and to work with the voltage regulator belonging to that unit. At present there is one auxiliary exciter set for 5 units, but in the completed station it is contemplated that there will be additional sets, each acting as a spare exciter for a group of machines. Each spare exciter may be connected to its own bus, to which the field of any generating unit of its group may be connected as shown in the diagram (Fig. 1). The auxiliary motor generator sets are driven from the 2,200 volt station service system.

A voltage regulator of the vibrating relay type controls the voltage of each generator. This regulator is equipped with compensation to prevent cross currents when units are in parallel

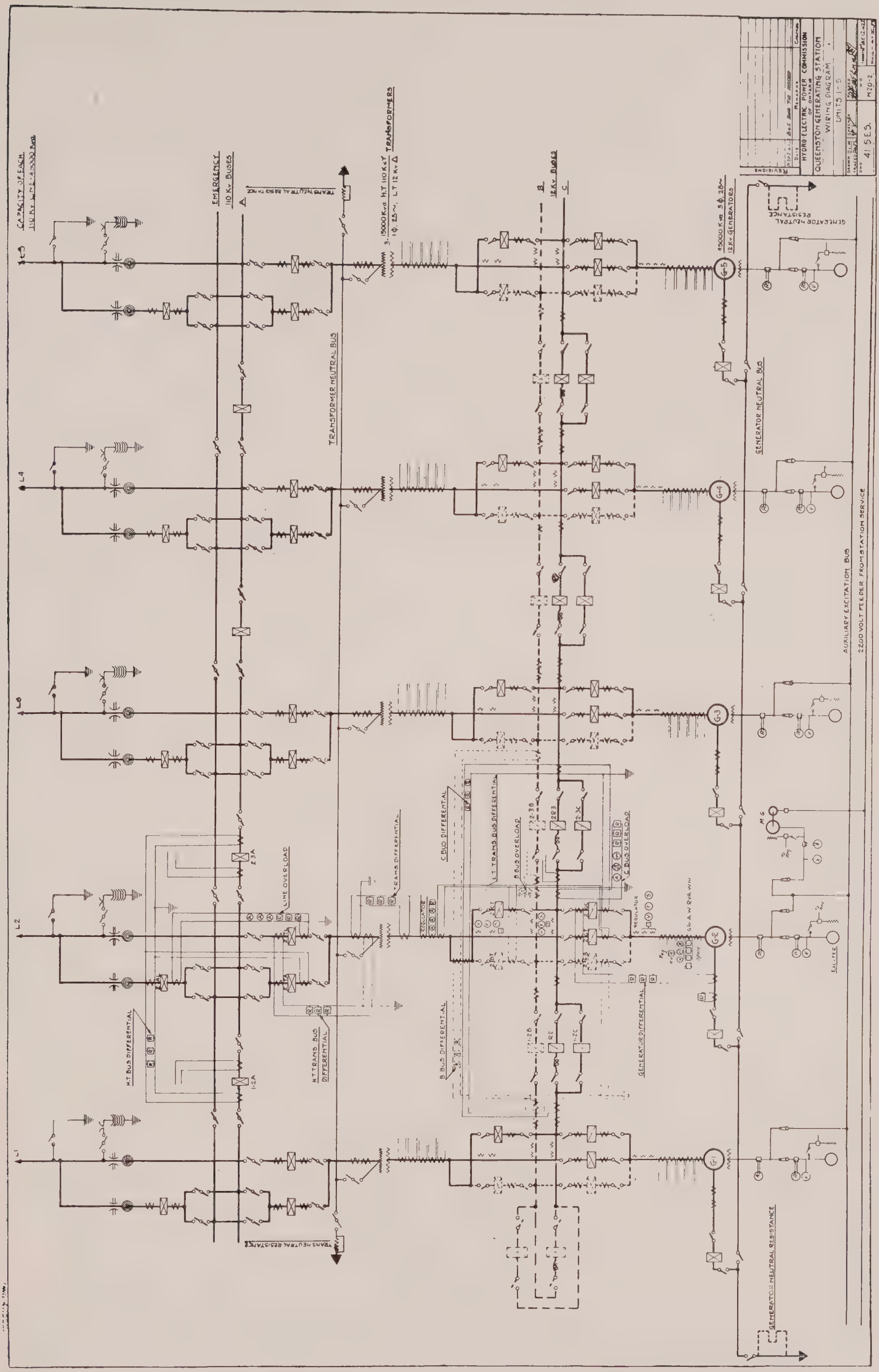
HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO
QUEENSTON GENERATING STATION
WIRING DIAGRAM
UNITS 1-5
EMERGENCY 110 Kv BUSES
TRANSFORMER NEUTRAL BUS
12 Kv BUSES
GENERATOR NEUTRAL BUS
AUXILIARY EXCITATION BUS
2200 VOLT FEEDER FROM STATION SERVICE
GENERATOR NEUTRAL RESISTANCE

Figure 1

on the 12 k.v. bus, also with adjustable compensation for ohmic and inductive drop in transformer banks and lines. Each is provided with a device for maintaining a low maximum of exciter voltage in case of a drop of voltage due to short circuit, also with a device for cutting resistance into the exciter field circuit to limit the voltage in case of over-voltage due to overspeed or other cause.

No main generator field rheostats are used.

Relay Protection

The simplicity of the main connections in the plant and especially the absence of 12 k.v. feeders make it possible to use differential relay schemes for protection of apparatus and connections. This allows rapid automatic removal of defective equipment from service with a minimum of disturbance to operation. The apparatus and main connections of each unit are divided into the following groups:

- Generator.
- Main 12 k.v. bus.
- Auxiliary 12 k.v. bus (when installed).
- 12 k.v. connections of transformer.
- Transformer Bank.
- 110 k.v. connections of transformer.
- 110 k.v. buses.

Each conductor where it leaves the group, carries a current transformer. These current transformers are so connected to relays that if the current in each phase leaving the group is not equal to the current entering in that phase, the relay will carry the difference in the currents, or in other words the current to a fault. If there is no defect inside the group, current leaving will be equal to current entering and there will be no relay action, no matter how heavy the through current. To ensure correctness of operation, the following precautions have been taken:

1. Current transformers are of special design to give correct ratio even with heavy currents.

2. Impedance in secondary wiring has been kept low by short connections. The only equipment connected is the relays which are in the differential circuit and carry fault current only.

3. Current transformers are placed outside the oil circuit breakers which would insolate any group so that a defective breaker would be cleared on both sides.

All differential relays are of the instantaneous overload plunger type, except for transformer differential which are inverse time overload induction type. Generator differential relays have also a hand reset feature to increase the certainty of operation.

Each differential group of relays is arranged with multiple contact relays to trip the necessary circuit breakers to isolate the defective equipment. In case of the generator differential, the field circuit breakers are also tripped.

In addition to the differential relay groups, the following relays have been installed, Fig. No. 1.

1. A relay in the ground connection of each unit to give an alarm in case of ground current. No switches are tripped.

2. A directional relay on each generator, of the three element induction wattmeter type restrained by a spring.

The principal function of this is to check careless synchronizing. It trips out the generator oil circuit breakers.

3. A ground relay on the 12 k.v. connections close to the transformer bank on each unit. It protects this section of the wiring, including the transformer 12 k.v. bushings which are not included in any of the differential groups. This is an inverse time overload induction type relay.

4. A set of inverse time overload relays of the induction type on each outgoing line. This consists of one relay for each phase and one for grounds.

5. A set of inverse time overload relays in the main 12 k.v. bus between units to separate them in case the units drop out of step with each other.

An annunciator is provided with each unit which indicates by a drop and an alarm bell which relay was operated.

Several operations of portions of the relay equipments have shown that they function as intended.

Hydro-Electric Power in Niagara Falls

Niagara Falls, being at the point of generation of the Niagara System, naturally has everything in its favor in as far as the supply of electricity is concerned. Prior to 1917, the city distributed power obtained from some other source than through the Hydro-Electric Power Commission and limited its efforts to supply electricity for lighting and industrial power purposes only. Heating was left to the Company supplying natural gas.

Upon entering into the Hydro Union the old system began to take on new life and since that time there has been a very satisfactory growth in all departments. This is shown in the tabulations given herein. It will be noted that that the revenue from domestic service has grown to nearly three times that of the last year prior to Hydro while the average rate per kilowatt hour has become less than one half. The consumption has become nearly five times as great, while the number of consumers has increased 50 per cent.

In Commercial and Power uses growth is also shown in the revenue, while other statistics are very satisfactory.

The conditions shown in the foregoing led Mr. John E. Teckoe, Manager, Hydro-Electric Commission of Niagara Falls, to make a census of all his Commercial and Domestic consumers to secure exact information of all electrical heating and cooking appliances over 660 watts in use at the end of the year 1921. It was found that the system was carrying the following.

DOMESTIC USE

Year	Revenue	Consumption K.W. Hr.	Consumer	Avg. Month Consumption K.W. Hr.	Avg. Month Bill	Net Cost	Net Cost Prior To Hydro
1916	$21,733.29	....	2050	----	$......	....c.	3.5c.
1917	22,566.76	867,639	2273	31	.99	2.6	
1918	26,423.31	882,174	2447	31	.93	2.9	
1919	33,221.90	1,419,901	2648	45	1.05	2.4	
1920	46,839.29	2,378,263	2907	68	1.34	2.0	
1921	59,722.54	3,598,610	3048	98	1.63	1.7	

COMMERCIAL USE

Year	Revenue	Consumption K.W. Hr.	Consumers	Avg. Month Consumption K.W. Hr.	Avg. Month Bill	Net Cost c.	Net Cost Prior To Hydro
1916	$13,259.02	....	400	......	$......	......c.	Flat Rate
1917	11,012.51	651,884	405	134	2.27	1.7	
1918	10,692.04	528,376	418	107	2.16	2.0	
1919	12,639.15	899,210	456	164	2.31	1.4	
1920	15,366.26	909,516	488	155	2.62	1.7	
1921	21,208.01	1,376,527	528	217	3.35	1.5	

POWER CONSUMERS

	Revenue	Consumers	Avg. H.P.	Avg. Cost H.P.
1916	$ 9,613.01	80	--------	$.......
1917	18,804.36	55	713	13.49
1918	22,242.65	61	14[illegible]0	15.03
1919	24,686.72	75	1905	12.96
1920	28,739.95	86	2102	13.67
1921	33,220.24	90	2505	13.26

NOTE:—In taking over the Municipal System the Hydro were compelled to serve power users that had old City Power Contracts at a price that was less than the cost price of power at the generating station. The majority of these have now expired.

Appliance	No.	Connected Load
Electric Ranges	546	3553 k.w.
Circulation Water Heaters	217	432 k.w.
Fire Places	138	294 k.w.
Hot Plates	154	256 k.w.
Portable air heaters	233	165 k.w.
Total		4700 k.w.

The total capacity of service transformers supplying Domestic and Commercial users was 3,254 k.w. These took care of all of the appliance load shown in the foregoing as well as the lighting and all other appliances used by the 3,576 consumers.

We have in Niagara Falls one example of the typical conditions obtaining in municipalities served through the Hydro-Electric Power Commission. The growth is but the natural result of the confidence of the people in the whole Hydro scheme. It is recognized that the Utility is their own and exists for their own benefit. It is quite natural, therefore, that the natural benefits will increase in popularity and the many developments and improvements made in appliances using electricity will increase in favor. Low rates for service encourage the use of electricity, while the resultant increase in use results in those rates becoming still lower.

Eugenia Hydro-Electric Association

On Monday, May 15th, a meeting was held at Durham, at which representatives from the various municipalities served from the Eugenia System were present for the purpose of discussing detail matters pertaining to the operation of the Eugenia System, power costs, rates, capital expenditures, etc., with representatives of the Hydro-Electric Power Commission.

At the morning session some 70 or more delegates discussed these matters among themselves and formed an Association to be called "The Eugenia Hydro-Electric Association." At this session officers of the newly former Association were elected as follows:—

President—Mr. John Legate, (Chairman, Public Utilities Commission, Owen Sound.)

Vice-President—Mr. D. T. Small, (Secretary of the Hydro-Electric Commission, Arthur.)

2nd Vice-President—Dr. R. Hacking, (Chairman, Hydro-Electric Commission, Tara.)

Secretary-Treasurer—C. Elvidge, (Secretary Hydro-Electric Commission, Durham.)

Executive Committee

C. Filshie, (Chairman Hydro-Electric Commission, Mount Forest.-

Dr. H. G. Campbell, (Chairman Hydro-Electric Commission, Orangeville.)

Dr. McArthur, (Markdale.)

John Taylor, (Secretary Hydro-Electric Commission, Hanover.)

H. T. Hurdon, (Chairman Hydro-Electric Commission, Kincardine.)

At the afternoon meeting, the following representatives of the Hydro-Electric Power Commission were present:—Honourable I. B. Lucas, Messrs. R. T. Jeffrey, H. C. Don Carlos, T. C. James, S. L. Eisenhofer, D. T. Flannery.

Mr. Lucas, briefly addressed the afternoon meeting on behalf of the Commission and stated that the Commission was pleased to learn that the Municipalities on the Eugenia System had formed an organization, through which the Commission could discuss matters in common between the Commission and the Municipalities on the System.

At the morning meeting, a list of questions was prepared by the Association and submitted to the Commission's representatives for reply. Messrs. Lucas and Jeffrey gave all of the information requested, and explained the general operation of the System, as well as various details of the financial operation of the System the financial situation and answered numerous questions in connection with various phases of operation asked by the members present.

At the close of the meeting, the following Resolution was passed by the representatives of the newly formed Association:

"It was moved by Dr. L. G. Campbell, seconded by Mr. J. D. McDowell and carried,

1. That this Association after listening to the addresses and explanations of the Representatives of the Ontario Hydro-Electric Power Commission here to-day, do extend to them an expression of our appreciation of the trouble to which they have gone in preparing material covering the questions under discussion, and the very courteous and comprehensive presentation of facts and figures to this Association.

2. That we are of the opinion that a change might be made to the advantage of the municipality and private consumer, if the inspection department of the Hydro Commission would take steps to appoint qualified local inspectors in the various municipalities.

3. That the Ontario Commission should be asked to send a representative upon the invitation of the individual municipalities to explain to the citizens of such municipalities the conditions obtaining in the operation of the Eugenia System.

4. That the Ontario Commission be requested to furnish each municipality in the district with a typewritten statement showing the detailed costs of operation and maintenance of the Eugenia System and also the percentages and amounts paid by the several municipalities on operation and capital accounts.

5. That this organization should meet at least once a year, or more often if deemed advisable by the executive.

6. That a copy of this resolution be sent to the Hydro Electric Power Commission of Ontario.

(Signed)
President, John Legate
Sec'y C. C. Elvidge."

At the morning session Mr. C. Haliday, Chairman of the Hydro Electric Commission of Chesley, recommended co-ordination of the Eugenia System with the Severn and Wasdell Systems and also advocated that the municipalities of the other systems mentioned be asked to join with the Eugenia Municipalities forming one general association. Mr. Haliday pointed out that each system had practically the same problems, and at times there was considerable interchange of power from one system to the other, consequently, a great many advantages could be obtained by much closer co-operation.

The matter was finally left in the hands of the executive committee.

Hydro News Items

Central Ontario System

The Commission is renewing water and gas services in Cobourg in the portion King St. which is about to be paved.

A canvass for contracts is going on with a view to supplying lighting service to the new Provincial Government Park at Presqu'Ille Point near Brighton, where a number of new cottages are being built and the hotel is being enlarged and improved.

The Peterborough Branch of the Engineering Institute inspected the new generating station at Ranney's Falls and were entertained by the Hydro-Electric Power Commission in the evening. Representatives of the Municipal and Operating Department were present.

The Utilities Commission is rebuilding the pole lines on Main St., Picton, this season.

The citizens are enjoying wireless concerts at the Opera House by the kindness of Mayor Newman, who has installed his Marconi receiving set there. Mr. Newman has been successful in picking up broadcasting stations at Pittsburg, Madison and Schenectady, as well as the Toronto Star Station.

Construction has been started on the line to serve "Bowmanville-on-the-Lake." The Summer residents can thank Mr. G. Chase for the opportunity of enjoying the boon of electric service.

The construction of the Ornamental Street Lighting System in Trenton is proceeding rapidly. With this and the new paving Trenton will shortly have a very fine looking business section.

Rural

Contracts have been signed covering services to Cataraqui Village, Kingston Township. Work instructions covering the necessary pole lines will be issued shortly.

A meeting was held at Roblins Mills, Ameliasburg Township, on May 31st, and large and enthusiastic Committees are canvassing for contracts.

Niagara System

The Hamilton Hydro-Electric System have arranged for the purchase of a building now occupied by the Bank of Montreal, which they intend to remodel for use as an office building. The ground floor will be made into a very attractive salesroom. The building is well located near the centre

of the business district, and the new quarters will be a wonderful improvement over the present office and salesroom, which are in the basement of the City Hall.

The St. Catharines Hydro-Electric System are getting out plans for a new sub-station, which will be of the outdoor type. According to present plans, the construction work will be spread over a couple of years, and additional equipment added as the load increases. The old sub-station is becoming quite inadequate to handle the rapidly increasing loads.

The Village of Belle River will submit Hydro Enabling and Money bylaws on July 13th, and the construction of a line from the Commission's Essex high tension station will be commenced immediately the bylaws have been passed. Sufficient contracts have already been obtained from the residents in the village to assure the System being on a self supporting basis from the commencement of operation. Sufficient rural contracts have been obtained in the Belle River district to warrant the construction of approximately fifteen miles of line almost immediately.

Work will shortly be commenced in connection with the construction of a line to supply the Village of Merlin and also a brickyard at Fletcher. A sub-station will be located at Fletcher and Merlin supplied from this Station over a 4,000 volt line. Sufficient contracts have been obtained in the village to assure the proposed System being on a paying basis from the start.

Rowe Lawler reports that meters are being read in the Ridgetown Rural Power District for the first time. Jim Wilson, says, "Me, too, in Dorchester Rural Power District."

Should sub-station buildings that are lined with pressed brick be painted on the inside? We were wondering whether this is something new in fashions, or has the painting been omitted to keep down the cost.

Rideau System

Mr. H. F. Shearer has resigned his position as Manager of the Smith's Falls Hydro-Electric System, in order to take up a similar position with the Municipality of Welland. Mr. Shearer, whose departure is greatly regretted in Smiths Falls, was tendered a banquet by the Smiths Falls Board of Trade, at which he was presented with an address and a handsome present subscribed for by the principal business men of the town. Welland is to be congratulated on securing Mr. Shearer's services.

The Municipality of Perth is showing what can be done by efficient management. In spite of increase in the cost of power, only a very slight increase in the lighting rates has been put in force while the power rates have not changed. At the end of last year this municipality was able to accumulate a surplus of over $5,000, and is well on the way to another year's successful operation. Mr. R. J. Smith, who is responsible for the successful showing, makes the business of wiring and sale of appliances an integral part of Hydro operation.

The Village of Lanark, with a population of rather less than 500, has secured 106 Hydro consumers, and continues to show that a small village can successfully operate under Hydro management with a comparatively high cost of power. There is every indication that the price of power to this Municipality will be considerably reduced at the end of this year.

St. Lawrence System

The Commission has practically completed the re-insulation, to permit operating at 44,000 volts, of the Morrisburg-Brockville line between Morrisburg and Prescott, and the remaining section should be completed about the end of June.

A request has been received by the Commission for an estimate on the cost of supplying electric energy to the Police Village of South Lancaster.

———

An extension to the rural line on the Ridge Road in the Chesterville Rural District is being constructed to supply 10 additional contracts.

———

The Village of Spencerville is now ready to be served with Hydro power. A 2,200 volt line, 13 miles long, from the Town of Prescott is now completed and will serve Spencerville and the surrounding rural district. There are at present about 60 customers on this line, and it is probable that we will secure a saw-mill load of 20 h.p. in the near future.

Main Cofferdam, Cameron Falls, Nipigon River

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CONTENTS

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OUR CONVENTION NUMBER

This number of THE BULLETIN is devoted wholly to reporting the Convention of the Association of Municipal Electrical Utilities, which was held at Niagara Falls, Ont., on June 22nd, 23rd and 24th. That the Convention was a complete success goes without saying. The attendance, though not quite so great as at the Convention held at the same place a year ago was exceptionally good, and the papers and addresses cannot be considered otherwise than of high standard.

Although the Association continues to show growth, yet there is a large number of municipally owned Electric Utilities in Ontario, who are to be found missing from its membership lists. The organization is doing a real work and should be supported by every Utility in the Province. None are too small to be benefited by it. Even though it may not be possible to be represented at all of the Conventions, yet the moral support counts for a great deal, and occasional attendance at the Conventions will result in greater benefits than can be gained from reading printed reports.

THE A.M.E.U.

By M. J. McHenry

With the formation some years ago of the Engineers' Section of the Ontario Municipal Electrical Association, the initial step was taken which has since resulted in an association of municipal electrical managers, superintendents and engineers with affiliat-

ed Hydro engineers and commercial men. The original organization served its purpose in the early days of municipal ownership, but its scope was too limited, comprising as it did only Hydro officials and being a branch of another body. The need was felt for an association which would be representative of all publicly owned electrical corporations in Ontario and which would also be self-governing and self-controlled. Thus we have the birth of the Association of Municipal Electrical Utilities some five years ago.

The organization to which we belong represents, and is directly controlled by the executive heads of municipally-owned electrical utilities in Ontario. It serves to bind these executives closer together and to foster a spirit of helpful co-operation among all sections of the electrical industry. Twice a year it brings together its municipal members, Hydro engineers and representatives of the manufacturers and jobbers and facilitates the interchange of ideas beneficial to the industry. Frequently we are prone to criticize the ideas of others simply because we are not sufficiently acquainted either with the author of the conditions under which he is laboring. By meeting together the opportunity is presented to become well acquainted with each other and with the problems which confront each one of us. In this way alone our association proves its inestimable value and justifies its existence.

Moreover, there are many other ways by which the A .M. E. U. strives to serve its members. By co-operation with the Ontario Commission it has been able to effect changes in regulations and standards of value to all its membership. Through joint effort with other central station bodies in Canada, and with the manufacturers, it is expected that revisions of Canadian regulations useful to the industry will be obtained, and that it will be possible to standardize in a more definite manner electrical equipment in the country.

In some quarters there has been at times a question as to the necessity and usefulness of the A. M. E. U. In the writer's opinion, the conventions of the association are of benefit even if we only get together once or twice a year and become well acquainted. All municipal engineers should know one another in order that they may be able to consult with one another and discuss on a friendly basis any problems which may arise.

A member of any association will obtain benefit from that association in proportion to the amount of effort which he put into the association. Undoubtedly we are all interested in our own association and anxious to see that it attains its highest efficiency. Therefore, let us all put our shoulders to the wheel and push forward for the ultimate success of the cause with which we have cast our lot. By wholehearted co-operation only may we expect to continue the success of the A. M. E. U. and reach the "peak load" of our desires. So, altogether, let's go.

Opening Address by the President

M. J. McHENRY, Walkerville

IN opening the mid-summer convention I wish to again welcome all of the various members of our Association and the guests whom we have with us here to-day. I think that probably this will be the most enjoyable convention session that we have ever held, as it is in the month of June and in such an ideal location as we have at Niagara Falls.

I am glad to see so many members of the Association present, and trust that each one of them will obtain something of interest and value, some little information or form some bonds of friendship which will be of benefit to him throughout the balance of the year.

Your Papers Committee has endeavoured to plan a programme which should be exceedingly useful to the membership of this Association. The programme this time is one just a little different to those which we have had at past conventions. We have introduced some phases which are entirely new to this Association. They are subjects which are becoming increasingly interesting to the industry as a whole, and I am sure that benefits will result from the papers we will hear read and also from the discussions.

The Conventions Committee has endeavoured to make the programme, other than the papers, one which will interest all of the delegates, and I trust that you will appreciate the efforts of these two committees, and that you will leave this convention fully satisfied and saying that you have attended a really successful convention.

May I just express to the members of the executive of the Association and to the members of the various committees, who are responsible for the completion of the arrangements for this convention, my own personal appreciation of their work. All of the members of the various committees have been very active and have left practically nothing for the President to do, which I appreciate very much.

Mr. M. J. McHenry, President

Since we met in Toronto in January, there has been a considerable amount of work carried on both by your executive and by the standing committees of the Association. Since that time, also, a new standing committee has been formed, at the invitation of the staff of the Hydro Electric Power Commission, known as the Rate Committee. That committee will report at this session along with the other committees. Reports given by the various members of these committees, I am sure will show to the Association that we have been active between convention periods.

Possibly some of the members wonder why we did not meet in Ottawa last week, particularly after the questionnaires were sent out by our Secretary. It was suggested by the Canadian Electrical Association that this Association hold its convention at the same time and place as theirs, namely, in Ottawa, on the 15th, 16th and 17th June. It was considered by our executive, and in order to obtain some idea of how the membership at large felt, I asked the Secretary to send out the postal questionnaire which you all received, but which you all did not return. From those returned it would seem that it was a very divided question, or that opinions upon it were greatly divided, and while I think the majority were in favour of going to Ottawa it was not very definitely stated. The executive, when they considered the arrangements for this convention, looked into the question of going to Ottawa and holding a joint convention with the Canadian Electrical Association, or at the same time, with joint sessions; but they considered that Ottawa was too far from the centre of our membership and that it would not be advantageous for this Association to hold a convention in Ottawa. It was further felt that it would be better for the membership of this Association to hold the convention again at Niagara Falls, when the various members would have the opportunity of seeing the Queenston Plant in operation. We have observed the construction of this plant for the past three or four years, and now we will be able to see the plant actually in operation. Consequently it was decided to hold the convention again at Niagara Falls.

There is nothing further that I have to say, just at this time, except to again welcome you and to wish you a very pleasant and interesting session.

Co-Operation

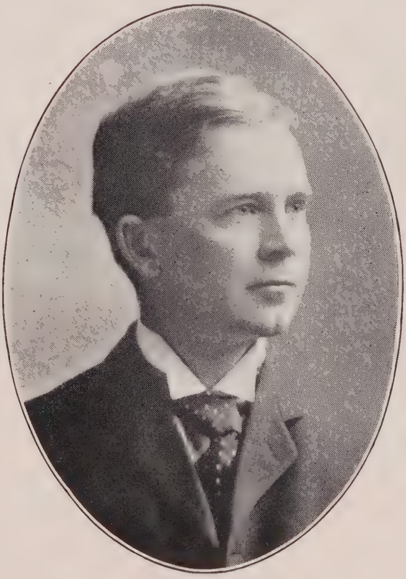
Address by Honourable I. B. LUCAS, Counsel for H. E. P. C. of Ontario

I do not know who wished me on this convention. I do know that a member of the committee, Mr. Jeffrey, called and said you are going to have an annual banquet here, and very kindly invited me to attend the banquet. Then, after I had gladly accepted, because I knew the air over at Niagara Falls is very good, and, since I have been here, I know the ozone is perfect. I always know that—it is the kind of pep which is good for a meeting and makes a banquet go as I have seen this one go to-night.

Then it was suggested to me that my name was down on the programme to make some remarks here on "Co-operation." Well, the only qualification I have for making any speech on "Co-operation" is that I know very little about it and the occasion of speaking to a lot of experts on co-operation by one who knows nothing about it ought to have its humorous side—and this is a banquet!

The Chairman has said a word or two, and chairmen sometimes take liberties, when he said that I perhaps deserved some consideration for my work in connection with the Hydro-Electric Commission. My work on the Commission is of a comparatively recent date. Any interest that I may have had in the Hydro and the Commission was on the political side of it, when I was associated with the government that put through the early legislation or nearly all the legislation. It is pretty hard to understand all of it, but I think I had a hand in all that legislation which is now known as Hydro-Electric Legislation.

Now, gentlemen, I assume that you did not ask me nor suggest that I should speak to you upon co-operation in any narrow or technical sense. You do not want me to touch upon the different co-operative organizations. Time would not permit it, if I wanted to. You can gather all that information as to the various co-operative societies, the Farmers' Clubs,



Hon. I. B. Lucas

and the egg clubs, and the buying and selling, the various co-operative efforts which are all very well known.

There is another branch of co-operative efforts about which I might speak if this were the time and the occasion. The efforts at political co-operation; I could speak about that with some knowledge and some wealth of expression, as to the political co-operation with the Farmers' organizations in the Province of Ontario. One serious word about that. The farmers' clubs are rural organizations for business purposes amongst the farmers. Without introducing one word of partizanship, I venture to think that they have made a mistake and that time will show that they have made a mistake when they made that centre for business purposes a political organization. The very first foundation principle of all community organizations along co-operative lines for business purposes, whether in the city or in the country, the first commandment, the cornerstone of it all is that the community organization must be non-partisan, must be non-secretarian, must be non-exclusive, and must not only declare itself for all classes but must be in actual practice, interested in all the classes equally; and I must say that one word, in passing, that those are the foundation principles, I believe, of every sound, community co-operative organization, no matter to what branch of industry it may be devoting its energy.

Then if I am not to talk about particular co-operative organizations, I perhaps can talk about it on more general lines.

We live in a co-operative age. Big business developments of the last fifty years have been a phase of co-operation—the co-operation of the small capitalists, to a very large extent, to do in a body what they could not do individually. If we take, in a very broad and general sense, the modern development of democratic government, it is a development of co-operative effort of the people to govern themselves, as against autocratic government. In short, our modern civilization in all its branches and in all its development, whether in governments or in the economic development of the country during recent years, and the government domain for many years, has been a drift towards everything that is essential and important in co-operation.

What is the matter with Europe to-day? What was Lloyd George trying to do down at Genoa, but trying to get better international co-operation; and so with the movement at the Hague, and the others, the Disarmanment Conference—all efforts to get better co-operation amongst the nations. And what is the foundation stone, the corner stone of all that co-operative effort is to show some faith and confidence in the other fellow and the willingness to take a fair deal. If Lloyd George and the others can convince the remainder of the world that a square deal is all they want, then they have the co-operative spirit.

The dominance of the co-operative spirit, as against individualism, which is to get what you can and let the other fellow take care of himself and let the devil take the hindmost—that

has been the dominating spirit of industry and of national life in the past —but co-operation as we understand it, to-day, and as it is coming to be understood, is launched on a much higher plane. Democracy, as we know it to-day, triumphs to-day; but in the eighteenth century was essentially a fight for rights, a fight for the rights which we think are ours, as the masses of the people, which were in the possession of somebody else. That in short was the struggle of a hundred years and more for democratic government or for constitutional government, or whatever way you wish to put it,—a struggle for our rights, the rights of the people in the possession of somebody else—a great and tremendous struggle, a constitutional struggle for democratic government by the masses of the people, continued through all these years,—a struggle by the masses to secure the right to govern themselves, a struggle to secure freedom, to secure civil and religious liberty, and to secure the various rights of property.

As we have gone on during all those hundred years or more, there has grown up besides that, hardly recognizing it as it came into being, incidental to our great struggle for our rights for democratic government, this other great conception which I pass on to you to-night as the conception of this century, not a struggle for our rights, not what has been the outstanding struggle for the last hundred years through the civilized world, but this greater conception which has grown up, as I say, incidental to the other, that we must give other people their rights as well as obtain them for ourselves, and give others justice. That will become more clearly the dominating idea as the years go by, to give others their rights, whether amongst individuals or nations will be found to be not only the dominating idea but will be found to be good in international politics amongst the nations. We have this great idea emphasized, of course, intensely, by the Great War and advanced immensely by the war. If we have not grasped that idea of the war, then I feel we have failed to grasp what is the great idea of the war, that civilization, the good of the world, future permance of world peace, must rest on world justice; and that the day for sharp international bargaining, has gone by, even as a good business proposition for a nation or a people. And so we have the League of Nations, and we have all the struggles to bring about international co-operation based upon mutual good faith, upon confidence in each other, and upon world justice.

The big men of the past have been the captains of industry, the individuals who have developed the resources, who by their energy and force and driving capacity for that sort of work have forged to the front, and, while not criticizing them, it has been the general rule, I look out for myself, let everybody else do the same, and, as I said before, the devil take the hindmost,—the struggle of the individual; and I think it is coming to be the big idea of the day that the great men in the future centuries will be the leaders in co-operative movements among the nations for the

square deal for the people, rather than the men who by their own efforts have built up great individual fortunes.

Co-operation as an economic principle is more or less new in the economic life of this country, but not so in Europe. The pioneer life in new countries, with sparce populations, stimulates independents, calls for individual effort, calls for men of great self-reliance, and calls for great initiative. Do not understand me as for a moment belittling in any degree the efforts of the pioneers, whether in industry or in any branch of work, in this country or on the American continent. These men have done a great work under conditions which demanded that sort of work. They deserve great credit for the progress which has been made on this continent, a continent with sparce populations, and which needed the great captains of industry here. But the scene has changed. New conditions and methods have replaced the old methods. Whether we like it or not, the efforts are for co-operative effort in the economic life of the country, as against individualism. It is world wide, and it is sweeping across all countries to-day in their governmental activities, and in one form or another you have co-operative efforts sweeping into economic fields in the life of this country and of this continent, at a very rapid rate, indeed.

What will cause that. Democratic government, increase of population and wealth, the growth of great cities, scientific knowledge, modern methods of industry, modern means of travel and intercourse. All the things which go to make up modern civilization demand new methods of procedure and demand fair play for the masses of the people; and all that is developing the great co-operative movements that are now in progress. And I venture to think, if we look into the future, we will find it moving with great rapidity, occupying many fields in this continent.

In our public utilities, you gentlemen who are here, the executives of these public utilities, and the Hydro representatives who have spent their life and their energies, most of them being young men, have, in Ontario at any rate, established a field of co-operative effort on a very sound basis and the most successful basis which we have in Canada and you public utility men, in all its various branches, are practically the pioneers in all big movements in co-operation in the Province of Ontario.

If I have made myself clear, the idea I have is this: The leaders of the future, the men most in demand in the future are men who can be leaders in co-operative movements and co-operative efforts of different kinds in the interest of the people.

In addition to the energy, the capacity, the industry and the integrity that individuals require, the successful co-operative leader needs all that and he needs other gifts as well. He needs to know many other things in order to be a successful leader in co-operation. He needs to know how to deal with the public, in order to be a successful worker. He must have wonderful patience, in my opinion. Great reforms and changes in the business methods and in the ways of thinking

of the people are not brought about by one step but are brought about by advancing slowly step by step, and the man who is in the work, anxious to proceed, is always in danger of being impatient, with the crowd; they will not go as fast as he thinks they ought to go, and they do not see as clearly as he does, and the successful public utility leader, the leader in the wider branches, must have patience with the public. You cannot go faster than public opinion will support you; you must allow it to grow, and you must be one of the men to help it develop. You must have patience for that. You must not have such vaulting ambitions about the particular branch in which you are that you grow impatient with those with whom you have to work because you cannot get everything you want right now, that you will not accept anything because you cannot get everything you want. You must also have other qualities. You must remember that to get anywhere you must start where you are to-day and go step by step. You must have a sense of humour—and I fancy you have by what I have seen.

You must have unselfishness and you must have a sense of humour if you are to be a successful man in co-operative efforts dealing with the public. You must have a balanced judgment. What does that mean? Ordinary every day common sense. That is a very necessary ingredient. You must have ability to differ with other people without being contemptous of their opinions. And I believe the one most essential quality of all that you require, if you are to be a real leader in co-operative efforts is that you must have a decent amount of faith in the good intentions of the average man with whom you deal. He wants to do the right thing, and you must have some faith in his good intentions to go on and do the best he can for himself and others.

Now I have already taken more than the allotted time, but if I were asked to-night what is the one great obstacle under our democratic system of government to the successful development of co-operative efforts, whether in public utilities or in other directions, I would say it is too much carping criticism on utterly inadequate knowledge and information. I do not want to emphasize that but I am going to close by reading some portions from a letter from a Hydro official which has come to my attention.

He says, amongst other things, in writing this letter: "I have come to the conclusion that my wife is right. She says that I am crazy. I have been back at the office four nights this week planning and working out some new ideas for the advantage of this institution. My days are so full of ordinary routine that I have comparatively little time in office hours for testing new ideas; so I come back after dinner and make my wife a temporary grass widow. Mind you, I am not complaining of the work. A good engineer or accountant finds no drudgery in his task. I suppose an eminent surgeon very rarely stops to yawn when removing a fellow's appendix.

We have seen the institution grow from small beginnings to its present immense proportions. Our estimates of success and expansion have been

largely exceeded in actual practice. We have become enthusiasts. There is no department head or a deputy but believes that this Hydro effort is the biggest institution in Canada, bar none. In order to make it a success there is not a man among us who would not be willing to stretch his working hours, without thinking particularly about salary. Here, however, is the sore touch. Some speakers and legislators and some writers in newspaper offices . . . . . misrepresent the motives governing some course of action, and minimize the importance of what has been done. Some of them go further and intimate that the opinion of a Hydro official is unworthy of confidence . . . . they intimate that his estimates are likely to be cooked in order to suit some propaganda . . . . Well that gets under my skin. There have been several inquiries concerning the administration of the institution. The honesty and capability of the officials have been vindicated more than once.

. . . .

Some of us are beginning to feel like ticket-of leave men, reporting to the police, and that is why I am writing this letter. Criticism is useful for a man, as flees for a dog—it has a livening effect; but too much criticism, like too many flees, is depesrately disspiriting."

I am an optimist. You should all be optimists in this great movement, and I believe our optimism is based on good grounds. I believe opportunities as big and as great as have ever come to any body of men are before you in Ontario in the different departments to which we may be devoting our energies; and may you prove to be as big and as great as the opportunities which are before you.

Public Health as a National and Industrial Asset

Address by CHARLES J. O. HASTINGS, M.D., L.R.C.P.J., Medical Officer of Health, Toronto.

I want to thank you, in the first place, sir, for this privilege and for the compliment you have paid me in asking me to be present to-day and talk to you, to have a heart to heart talk with you on the subject which is truly of vital importance to all of us, namely "Health."

As engineers, you will naturally want to know whether, in our endeavors to prevent disease, we are properly equipped, and as to what kind of a plant we have installed, and as to what our organization is, in order that you may be in a position to constructively criticize us or to offer suggestions as to what we might add to that organization, to make our work more efficient.

The whole history of preventive

medicine, at least the evolution of it, is rather interesting, and would be more so if it were not for the lamentably slow progress that it has made until practically within the past decade. However, in all generations, and in all nations, there have been a sprinkling of people who have had vision and who have realized the importance of safeguarding the public health. However, one can scarcely conceive of that being the case when one realizes that it is only within the past ten or fifteen years than any decided advances have been made. One can scarcely realize that four hundred and ninety-five years before Christ district health officers were appointed in Rome. And when one goes back to the sanitary code which was compiled and issued by Moses, a code which will stand comparison with any sanitary code at the present time, one appreciates that it was most creditable, in view of the limited knowledge they had of the cause of disease and the ways and means by which disease might be controlled. However, unfortunately, the doctrinal delusions and the superstitions of the Israelites —and I am sorry to say, sir, that these delusions have been handed down even to the present day—that disease and pestilence were a visitation of Providence and an evidence of Divine wrath, and therefore that any attempt on the part of man to control or interfere with it was practically flying in the face of Providence. It was no doubt this that Ruskin had in mind when he said, in writing on public health matters, that any interference or any regulations which tend to improve the health of the masses was viewed by them as an unwarranted interference with their vested rights in inevitable disease and death.

Now that was wonderfully well expressed. It demonstrates the fact that Ruskin visualized the matter and had a full appreciation of their delusions; and yet is it not a regrettable fact that one hears in the funeral service, even up to the present time, "The Lord giveth and the Lord taketh away." Now, we know, as a matter of fact, that the proper expression of that, in many cases, would be, in the light of modern knowledge, "The Lord giveth and the municipality taketh away."

I hope the time will come—I am afraid it will not be in my time—when every municipality will be held guilty of culpable negligence where, in the event of any person dying of a preventable disease, it can be demonstrated unquestionably that the disease could have been prevented by the municipality and it has failed to do so.

We know what happens in any industry when any one employed in it meets with an accident caused by neglect on the part of the industry. That industry is held responsible. Why should not a municipality be responsible for those diseases, particularly those of a character that we know to be preventable?

People have begun to waken up to a realization of the fact that the blame does not rest with Providence but rests upon us, and that we can no longer relieve ourselves of the responsibility by placing the blame on Providence.

I grant you that years ago it was a source of comfort and relief to the

medical man to hear the minister say, when a little one has passed away, that the Almighty has thought it wise to take the little lamb into the fold in order that the old sheep may follow. Yes, it was rather comforting to him, if, through lack of proper knowledge and probably in the light of knowledge possessed at the present time, Providence was being blamed for the death. You remember our dear departed friend, Sir William Osler. When he visited his old home in Dundas some years ago, he met one of his old schoolmates there. She was in mourning, and he was conversing with her and said: "Well, Mary, I understand you are married?" "Yes." "Have you a family?" And she replied, "Yes, Dr. Osler." He asked, "How many have you had?" and she said, "We have had seven altogether; four of them have passed on." "Well," said Sir William, "what was the trouble?" "Cholera infantum, infantile diarrhoea, cholera morbus"—all were due gastro-intestinal troubles,—"however" she said, in a very plaintive and reconciled way, "you know, Doctor Osler,"—he was not Sir William at that time—"I have been reconciled. I realized it was the Lord's will to take those little ones." And, in his usual, frank way, he said: "Mary, I want to tell you that the Lord had nothing to do with taking those children away. They were all poisoned by milk, poisoned by dirty milk." It was dirty milk fed to those children that caused all those diseases; it was therefore responsible for their deaths, and Providence had nothing to do with it. It was the lack of the application of the knowledge that we possess at present that is causing most of those deaths; and so it is, in large measure, in regard to all communicable diseases. But when one realizes that, even back three-quarters of a century ago, Benjamin Disraeli, talking over the heads of his co-members in the British House of Commons, said: "Public health is the foundation on which rests the happiness of the people and the strength of the nation.

Three-quarters of a century later, in August, 1918, the Right Honorable David Lloyd George, in addressing a conference in Manchester, his home town, said he had just read one of the most humiliating reports that he had ever been required to read since he had entered public life, and that was the report of the medical examining board. "Gentlemen," he said, "if the people of Great Britain had been looking after the health of their people as they should have been doing for the past twenty-five years, we would have had a million more to place in the field than we had, and the war would have been won months ago." You cannot make, says David Lloyd George, an A1. nation of a C3. population. And if any nation is going to be efficiently equipped, whether in times of war or of peace, for any emergency, they must take a more intelligent interest in the health of their people than we have ever been doing in the past. This is the duty of the State, and a duty from which they cannot possibly find any just means of escape.

It is not many years since the principal duties of a department of health were the abating of nuisances, cleaning up back yards, and improving the general surroundings; but, fortunate-

ly, with the discovery of the germ origin of disease, which was practically fifty years ago, there was new light thrown on the possibilities of preventive medicine; they realized then that offensive odors were not the cause of disease, but the diseases were due to some specific germ. Practically every disease is due to some specific germ, which is responsible for that disease; and that germ must be transmitted from the person affected to those who are unaffected in order that they may contract it. Therefore, with that knowledge, with the indisputable evidence of the germ origin of disease, it has become the duty of departments of health to find the haunts and habits of these germs, and to consider carefully the ways and means by which they are transmitted from one person to another.

Now, in regard to the general blanket duties of every municipality and every department of health. Naturally, in endeavoring to combat these invisible foes of the race, we consider first what are the most far-reaching—what conditions exist in a municipality which are likely to affect every person in that municipality. The first article which one considers is the water supply. Everyone drinks water. After that, the next is the milk supply. Every person does not drink milk, but every person should drink milk. Therefore it is quite apparent that every municipality should be held responsible for the delivering to their people of a safe water supply. There is only one disease however, that concerns us in this northern country, as far as the water supply is concerned, and that is typhoid fever.

Every municipality should be required to safeguard their water supply. It is a simple matter to do it. If the water is in a perfectly clear condition practically free from suspended matter, chlorination will make that water perfectly safe; but if the water is not in that condition, then it requires filtration and chlorination.

People, naturally, heard so much talked about filtration and the cost in connection with it, that they thought that surely the filtering of the water would make it all right. It does, at times, but we have to bear in mind that the only water that is safe for a municipality to use is a water that is safe at all times.

In Toronto, we have a bacteriological examination of the water made six times a day, of water taken from the tap, that is, the water delivered to the people; and we have had occasion for fault finding as to the taste of the water, when we have had east wind and the decomposing vegetable matter in the water stirred up and the very small fractional part, of one part of chlorine in one million parts of water is used; but that, together with the decomposing vegetable matter, will at times, give an unpleasant taste to the water. However, in the past two years, not more than twice in a year has the Colon Bacillus got past us. In other words, there have been only four times in two years that the slightest danger signal of that disease has got past us. Therefore, we know that typhoid cannot be traced to the water supply of the city of Toronto.

By safeguarding the water and milk supplies of the municipality, typhoid

fever will become practically a thing of the past.

The mortality from typhoid fever on the continent of America in the last twenty-five years has been reduced seventy-five per cent. In Toronto, for instance, twelve years ago the mortality from typhoid fever was 40.8 per hundred thousand of the population. For the past four years it has ranged from 1.9 to 3.9 per hundred thousand of the population. And we know that reduction was not all due to the safeguarding of the water supply. After we got the water supply made safe, we had typhoid fever reduced to eight or nine per hundred thousand. Then we got after the milk supply; and that was more difficult to control, because there was the commercial aspect of it, and the dealers had to be considered ;and there was difficulty in getting our by-law passed.

However, it is astonishing the amount of real heart and soul we find in our fellowmen, when we get near enough to them. When we prepared the by-law to safeguard our milk supply in Toronto, I learned that there was a deputation coming down when it was to come up for its third reading, with the determination of blocking it. I asked the chairman of the board of health to ask that deputation to come into my office before going up to the council chamber. They did so, with some reluctance. The Secretary of the Retail Merchants' Association urged them to come in, saying it would strengthen their position before the council. When they came in, there were only two of those men who shook hands with me, and the others gave me a pretty cold nod; however, I was thankful for small mercies and I asked them to sit down; and I said, Gentlemen, now, in the first place, you must fully realize and appreciate the fact that I have no ulterior motive, no motive other than that of fulfilling a sacred trust and keeping faith with those who have placed that sacred trust in my hands, of efficiently safeguarding the health of the people of the city of Toronto. We know that milk is the most valuable article of diet that we possess, and the people ought to be consuming from three to four times as much milk as they do consume; yet milk has been responsible for more disease than all other articles of diet put together, when sold in the open way on the market. This by-law which we have had prepared, only requires that you use the same decent cleanliness in connection with the milk supply that you would use in connection with any other food supply placed on your tables. You, gentlemen, are aware that the vast majority of milkers in the country do not wash their hands before milking. No, they wash them afterwards, because they realize the filthy condition of the udders which they milk.

How many of your wives would tolerate you or your help on the farm coming in, after cleaning out the stables and cleaning of the horses, and sitting down at the table and cutting the bread and handing it around for all to eat without washing your hands? How many of your wives would tolerate that for a minute? Yet you might do that every day in the year and not injure their health as

much as would be done by having the milk handled in the way it is usually handled. Milk is not only contaminated by the way it is taken from the cow, but it affords an excellent breeding place for germs. Milk with a thousand bacteria to-day, at a summer temperature, or the temperature of a living room, will contain several millions of bacteria in twenty-four hours after that. Now, if you will just very briefly run over with me the various clauses in this by-law, and if you find anything in any one of the clauses which you do not like, I will discuss it with you.

One or two raised objections, and I explained them away, and it was satisfactory to the rest of them. Two hung out; they said they wanted a satisfactory deal. I said, gentlemen, I want you to understand that you are not only getting a square deal but that I am simply discharging my duty, and that you, yourselves, in your own heart of hearts, would think I was falling down on my job and was asleep at the switch if I did not insist on this regulation being carried out. So, after discussing it for some time, they took another vote.

In regard to the pasteurization plant they said the time that I had allowed was not long enough. I said to them, "How long do you want?" Some of them said "Three or four months." I said, "We will not prosecute any person short of five months.

And, to make the story short, every one of these men came around and shook hands with me before they left, and there was not one of them went near the council at all. So that, after all, while we may think people are heartless and think that they have no regard for the health and lives of others, it is only because we have fallen down in our methods of educating them, because we have not got across to them the why and wherefore. We are living in an age when people do not want to be treated as machines and be told that they must do a certain thing, without being given an explanation. Explain to them the reasons—they are entitled to that—and after they have had that explanation, my experience has been that nine times out of ten they will be glad to co-operate with us, even at inconvenience to themselves.

When we control these two supplies, which are the principal sources of the transmission of disease, even when you get milk free from barn yard contamination, the only way you can get it safe is by pasteurization, that is, by the raising the temperature to 145° F. and maintaining it there for thirty minutes. By doing this, you destroy the disease producing germs, such as typhoid fever, scarlet fever, septic sore throat, diphtheria and bovine tuberculosis.

Probably twenty-five per cent of the herds of cattle in Ontario are suffering from bovine tuberculosis. Bovine tuberculosis is transmitted to children only. Probably not more than one per cent. of adults take it; but under sixteen years of age, twenty-five per cent. of all tuberculosis in children is of the bovine type. That has been demonstrated by the British Royal Commission, by the German Royal Commission, by the French Commission and by the Commission appointed by the United States after the late

Prof. Koch stated that he did not consider bovine tuberculosis was communicated to human beings.

The only way to efficiently safeguard your milk supply is to get it clean of barnyard contamination, and then make it bacteriologically clean by pasteurization. You cannot imagine the difficulties we were up against when we insist upon a clean milk supply. Every once in awhile some person would come back from their summer holidays and say, I cannot understand what in the world is wrong with our milk. It does not taste like it used to do and it does not look like it used to do. Why, we have just been out in the country and the milk tastes altogether different there, and it looks different. I said, I think I can explain that to you. Twenty years ago, when they started their milk campaign in New York city, they were supplying a certified milk. That is too costly for the average person to buy. It is procured under conditions which requires everything done as if in preparation for a surgical operation. The cows were kept in a rigidly carefully groomed condition, and the stables were in immaculate order; the milkers were required to put on freshly laundered suits before they milk the cows; and all the vessels are sterilized. I always tell them, in order to make assurance doubly sure, it is better to pasteurize the milk. But, one man who kept the largest dairy herd supplying milk to New York city, running into the thousands of heads of dairy cattle, came into New York city and went to one of the places where they were selling this certified milk. He was in a very high state of excitement and in a very aggravated condition of temper generally. They had been told about him, and were prepared for his arrival. He asked: Is this where you sell that stuff which you call certified milk? Yes sir, and they brought a little out for him to taste. He tasted it, and said, "Do you call that milk? It hasn't the taste of milk. I thought that was what you were putting off on the public. There isn't a taste of milk to that. Is that all the milk you have here?" "No, there is another kind here." And the young lady went back and by pre-arrangement, dropped about three drops of liquid manure into another tumbler, and poured into the tumbler some milk from the same bottle from which the other milk had been taken, stirred it up and brought it out; it was handed to the man, and he tasted it and said, "Now, that is milk. Any fool would know that was milk. That has the taste of milk; the other stuff hasn't the taste of milk!" I said, "You have just learned for the first time in your life what you have always considered the flavor of milk Now, we have taken the liberty of eliminating that flavor, and are trying to cultivate the proper taste for milk. If you want the old kind, you can make it yourself. You can keep the solution on hand."

Then this New York dairyman says, "Do you mean to tell me you have it pasteurized after you secure it in that careful way?" And he was told yes, we work on the same principle that the man did who was married for two or three years and then went overseas, and was away about six months when he got a cable ad-

vising him that his mother-in-law had died and asking "Will we cremate or bury her?" And he cabled back, "Take no chances, do both!" We also take no chances; so, no matter what disease we have in Toronto, we know they are not due to the water or milk supply.

Even though we had controlled the communicable diseases, that only constitutes a fraction of what a public health department is required to do at the present time.

The war through which we have just passed has taught us some valuable lessons. Some of the most valuable by-products of that war are those in regard to lack of physical fitness of our young men. Oh, what a reflection! No wonder Lloyd George said it was the most humiliating report that he had ever read—to realize that all the way from thirty-five to fifty, and in some cases, sixty per cent. of their men were unfit for service, when it came to the last reckoning. This was no particular revelation to those of us who have been engaged in public health work. The Life Extension Institute, of New York city, has been making examinations of adults, in the prime of life, from twenty-five to thirty-five and forty years of age ,and what have their findings been for the past ten years? That twenty-five per cent of those people, in the prime of life, who had not the most meager idea that they had any organic disease of any kind, were found to be suffering from organic disease of the kidneys; thirty per cent. were found to be suffering from some organic trouble in connection with the heart and arteries, increased blood pressure, premature hardening of the arteries, premature kidney disease and premature heart disease; and yet they were absolutely unconscious of anything abnormal, and considered themselves physically fit. Just imagine the smouldering fires in all these people.

What have been our findings where we have complete physical examination of children on entering the Public Schools? Over fifty per cent. of the children entering the public schools of the city of Toronto last year were found to be suffering from some physical defect which required them to be referred to their family physician to have that condition corrected.

There is the explanation of the humiliating conditions which were revealed at the time of the war; and I sincerely hope that all the nations will profit by it. The war revealed the fact that brain and brawn were the most valuable assets that a nation possesses. Think of the absolute disregard which we have had of that valuable asset.

The medical reports were most valuable to those who were then awakened for the first time. It was revealed to them that there must be something which was not being looked after in the Department of Health.

Now, you can understand that we can only control to a limited extent the communicable diseases, on account of the carriers and the mild cases which are going about all the time and spreading diseases at every turn. Even though we could have controlled those, it would not have prevented the conditions revealed only to a limited extent. Only a limited percentage of

those conditions could have been traced to having suffered from any communicable disease; but rather due to our not having started early enough.

Doctor Oliver Wendel Holmes, many years ago, said, "If you want a perfect gentleman, you must begin with his great-grandfather."

Another little incident that illustrated the importance of starting in time is that of a man who was running to catch the train, as it was steaming out of the Union Station in Toronto, some two years ago, and fell down on his job. As the train pulled out of the west end of the station, just a little in advance of him, and he came back with a very disconsolate expression on his face, the despatcher said, "Boss, you didn't run fast enough." "Oh, yes," the man replied, "I did, but I didn't start soon enough."

That is where the trouble has been, we have not started soon enough. If we are to profit by the experience of the war, and by the findings of the Life Extension Institute of New York and by the results and revelations of our complete physical examination of the children on entering school, we must start early enough, that is, we must start where eugenics leaves off. We are not responsible for the condition of the germ plasm and for what defects there may be in connection with that, from which we all have developed; but we are responsible for the conditions from that very moment that conception takes place. As Professor David Stair Jordan, of Stanford University, fittingly expresses it, the moment conception takes place the door to parental gifts is closed. In other words, there is no parental influence after conception takes place, after the ovum becomes fertilized, their future depends entirely on environment.

One of the conditions is—and the fact is lost sight of—that the infant is nine months old when it is born. We have not been looking after it until it was born, and we should have been looking after it before. And that is where we have been falling down in many of these cases.

The offspring, during the time the mother is carrying it and during the period of its development within the womb, is dependent wholly on the mother's blood. It does not require any scientific knowledge to appreciate the fact that the condition of the infant depends upon the condition of the mother, upon her general hygienic surroundings, her general precautions along all lines and her properly balanced diet. She may have plenty of food and still be starving. Thousands of our undernourished children are not in that condition because they have not had food enough; the majority of them have had food enough, but they have not been having a balanced diet, and they are practically starving with full stomachs.

What we want is a better knowledge of nutrition, in the first place, for the mother. The mother must have a proper knowledge of what kind of food she should take in order to have the necessary elements in the blood to supply all that is essential for the efficient development of her offspring during the time she is carrying it. Therefore, it becomes the duty of the Department of Health to have

organized, first of all, a pre-natal clinic or a clinic where expectant mothers will come to receive instruction. Then have these cases followed up by one of the public health nurses to the home; then a pamphlet to go into every home where we learn there is an expectant mother, as to precautions which she is to take for herself, both in her own interests and those of the expected child, so that every child shall have that which it is entitled to, that is, a proper birth and a sound development. Having secured that, the next thing is the care of the new-born child. This we have looked after in the way of Well Baby Clinics, where mothers come and are instructed in the proper care, feeding, bathing and clothing of their babies. Week by week they bring their babies there; and there is a card given to the mother, with the date of birth of the child, and other necessary information, kept up to date from week to week until the child is nine months old; and these mothers are now vieing with each other, and are comparing their baby's card with that of their neighbors; and if their baby is not developing quite as rapidly as their neighbor's, they want to know from the doctor and the nurse why that is so. That is a spirit of rivalry which will develop a better race, and that is the spirit which we want to stir up in every municipality.

After the care of the new-born child, there is the care of the child in the pre-school age. We have the child under observation, and if there is any physical defect found, the parents are referred to their doctor to have the defect corrected.

Then there is the complete physical examination of the child on entering school. Then again, we have the complete physical examination of the child on leaving school, not only to ascertain whether the weak links which have been threatening in the first place have all been properly repaired, but also to serve as a vocational guide, as to whether they should engage in certain lines of occupation. For instance, if there is any tendency to weakness about the chest, susceptibility to bronchitis, or respiratory trouble of any kind, they are strongly advised to engage in outdoor occupation, and certainly not to engage in any industry where there is dust to any appreciable extent.

Now, I am coming to the point which is of more particular interest to you gentlemen, and that is the value of the public health department to industry as an asset, and in what way it is an asset.

It is inconceivable that, while the child is carefully looked after during the time it is in the school, and while the child is in the public schools it is a liability, more or less, to the community and the municipality, then the moment the child starts out into industry, when he becomes an asset, he has been left to look after himself as best he can. In other words, after children have become an asset to the nation and the state, they have been neglected, in a large measure. It is only in recent years that we have had any particular interest taken in industrial hygiene.

Some seven or eight years ago, we established, in connection with the department of health in Toronto, a divi-

sion of industrial hygiene, and had a survey made of all the industries in the city; and there again we had an illustration of how one touch of nature made the world akin. We found a lamentable state of things, as far as care of trade dust was concerned; and we communicated with the individual employers in the industries, pointing out that they were maintaining a public nuisance which must be abated. They objected, at first. I had some of them come to the office. I had them appoint a deputation to come to our office and talked it over with them. I said, Gentlemen, have you ever stopped to think that it was bad business? Have you ever thought for a moment that any man living can do more work in eleven months than he can in twelve? Have you ever stopped to think, for a moment, that a man who is in a badly ventilated room, with too much or insufficient humidity, is going to drop ten or even twenty per cent. of his efficiency? You will go to your office in splendid form, in the morning, and give wonderful efficiency up to about eleven o'clock, and all at once you begin to get a dull headache, and become cranky and irritable; and you go out among your men and are looked upon as a crank by all with whom you come in contact; and you upset your men. You go back to your room, and somebody comes in, and he says, "Say, Bill, how in hell do you live in this place?" "Why, what do you mean?" "Why, this place is excessively hot." And you get up and find that you have been living in a temperature of 78 degrees. The same condition of inefficiency exists, in a greater or less degree, in the different rooms in connection with your industry, where you are expecting to get 100 per cent. efficiency from your workmen; and if you are employing five hundred of these men, you are paying at least fifty of those men for nothing at all. Is that good business? Isn't it taking a lot of your profits? Isn't it worth while for you to look into, for the good of your business alone, even if you do not consider the interests of those working for you, who are the cogs in the wheels of your industry and making all the money you are making?

Those men have spent, in the city of Toronto, hundreds of thousands of dollars in improving the ventilating and heating systems in their establishments, and also in the installing of devices for the control of trade dust; and I have had probably more letters from those men than from men in any other line in Toronto, thanking me for the suggestions they had received.

It was not their fault that they did not know. It was not their job, it was the duty of the department of health, and it is the duty of the department of health to see that every activity is carried out for the development of a fitter race, from the conception of the child until it passes on to the next cycle of existence.

Education—and I tell you that education is no easy matter, particularly when a man is getting on in years. Locke, in his Essays, compares men's brain to a lot of molten wax. For the first decade, it is easily impressible; in the second decade, it is hardening, and also in the third; in the fourth decade, it is a little harder again; in

the fifth, harder and less impressible; and in the sixth, still harder; until, in the octogenarian, when he is not constantly using his brain, his grey matter is pretty well consolidated, and you can ask him questions in regard to what happened in the morning, and in the afternoon he does not know anything about it. But if you say to him, "Say, did you attend such and such a public school?" he quickly responds, "Yes, sir, why I attended there. What is your name?" And you tell him, and he will say, "Why, I know you perfectly well." And he could go over the names of probably half the boys and girls who attended that school, and tell you who they married. But the information and events of the morning of that very day on which you are talking to him in the afternoon had left no impression on his mind. Hence the necessity for beginning our educational campaign early. If we do not begin it early enough in our schools, we must make the best of a bad job. As Sir William Osler said at the Academy of Medicine in New York, when discussing this question, I think the great factor for efficiency in education is reiteration, reiteration, reiteration. And one of his colleagues in the audience added to that, "Without irritation." It certainly requires tact and art to be able to rieterate as frequently as is necessary to drive a truth home and get the people thinking. You know Carlisle said, "but one out of five thousand thinks." If he had been in public health work, he would have said "One out of twenty-five thousand." We do not do very much thinking, outside of our own vocation, but are willing to allow the other fellow to do it for us.

In this connection, when one realizes the conditions which we have, even in the wasting diseases of middle life, kidney disease, premature hardening of the arteries, heart diseases, high blood pressure. All of us can recall the number of persons, in ordinary every day life—some person we knew well, just in his prime of life, passed away; and we perhaps attended his funeral, and it never dawned on us we may be the next, and it never dawned on us what that man died of, and why he should have been taken off at that time of his life. And how many in this audience ever go to their family physician, or go to their family physician every six months, and say to him, "Now, I want you to give me a complete overhauling, and give me a report as to just how every organ in my body is operating." No, you do not do that. But, how many of you, having a limousine, will fail to have that limousine overhauled at regular times? Is the limousine of more importance to you than your body? What good will your limousine be to you after your body is gone, or after one of these diseases progresses so that you are not living any longer, but the doctor tells you that by exercising certain precautions you will live a little while longer, when, if you had taken as much care of your body as you do of your limousine, you would be in good physical condition. Many of your troubles can be eradicated.

You remember about that certain Irishman who went into the bookstore and saw a book, written years

ago, "Is Life Worth Living?" And Pat says to his friend, "It depinds on the liver!" No matter how you view the remark, it was a double-header, it was a two-edged sword and was answered most efficiently. I do not know whether Pat was entitled to the credit or not, but it was a very creditable answer, because the condition of our liver depends on our methods of living, and our methods of living determine very much our physical condition, and the condition of our liver will determine largely whether we think life is worth living or not.

It is a very lamentable condition of things if any person here ever gets up at any time of day and has occasion to hesitate for a moment to consider if life is worth living. If you ever reach that point, for heaven's sake, consider that a danger signal, and find out from your family physician what is the matter. No man, until he comes to eighty years of age, should ever think of asking himself such a question, in a world like this, where the Almighty has given us so much to enjoy, and we are abusing our bodies to such an extent.

These are just a few remarks on this subject, but I am afraid I have exhausted my time. These are but a few of the rocks and shoals upon which we have placed the beacon lights by which we may shield lives from premature physical, moral and mental shipwreck.

Accident Prevention for Municipal Utilities

Address by WILLS MACLACHLAN, Employees' Relations Dept., H. E. P. C. of Ontario.

I WILL try to hold myself down to ten minutes, but there are a few points that, acting on the suggestion of the Committee, I think possibly may be of advantage to you.

Under the Workmen's Compensation Act as it stands now, if a workman is injured in an industry in Ontario, and if he is laid off for seven days, he receives compensation from the Workmen's Compensation Board, and his medical, surgical, and hospital fees are paid. If he should be so unfortunate as to be killed, his widow receives a pension for her life or until she remarries; their children receive pensions up to the age of sixteen years.

Where is the money coming from to do all this? It is coming, as far as the Electrical Utilities are concerned, out of the funds available to those Utilities. In Ontario the companies pay an assessment to the Workmen's Compensation Board, and that Board places that assessment to the credit of Class 22. The Municipal Utilities have the option of either standing their own losses, that is paying for any employees who are in-

jured, out of their own funds, or coming under Schedule One of the Act and paying their assessments to the Workmen's Compensation Board.

One hundred and fifty-two Public Utilities in Ontario have availed themselves of that option and have paid to the Workmen's Compensation Board a percentage of their pay roll, and the Workmen's Compensation Board has been looking after the employees.

If you have more accidents in your municipalities than in the privately owned companies, the Compensation costs will be higher, and the Workmen's Compensation Board will need more money to carry on. If you cut down the number of accidents, the compensation costs will be less and the Workmen's Compensation Board will not require so high assessments from you.

Up to last year we had a very successful proposition. We carried on at an extremely low rate. Last year we were unfortunate enough to have some fatalities, which ran the cost up. For your information I might say the cost of a fatality is about $8,000. For a totally incapacitated man of the ordinary mechanic type the cost is twelve to fifteen or seventeen thousand dollars. These costs you must meet.

The Workmen's Compensation Board, acting under Clause 101, can allow Associations within a class to be created for the prevention of accidents.

In 1915, the Electrical Employers' Association was formed. Its duty is to prevent accidents in the Public Utilities in Ontario, either in the Municipal Utilities or in the privately owned Utilities. The Municipal Utilities, in which we are particularly interested, have elected, in large bulk, to come in. That Association receives money from funds which you with the privately owned companies have built up, to carry on that work. The Electrical Employers' Association has been given the duty of reducing these accidents. It is a mutual proposition in which we are all interested. There are two ways by which we can strive to do it. One is by policemen. We can put on enough inspectors to go around and say: "You must do this, that or the other thing." That will get you so far. The other way is by the co-operation of those in the industry, by getting the men in the Utilities interested in preventing accidents and by having them do their own policing. That is the method I have been trying to have carried out. We have not tried the policing methods.

This is a mutual proposition for the prevention of accidents. If an accident happens, it has to be compensated for. Our only salvation is to cut out the accidents. It is a pure dollars and cents proposition. We have been able largely to cut them down, and even now, with our accidents of last year, we still have the lowest rate on the continent.

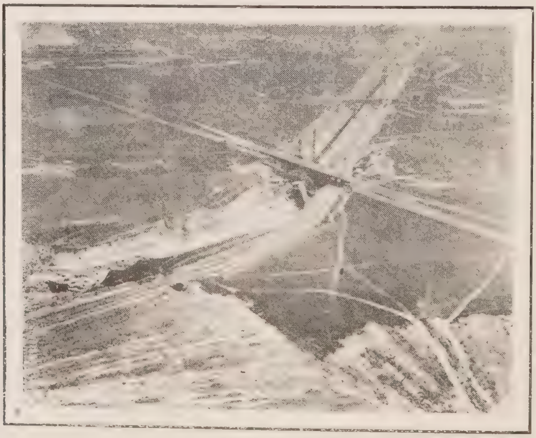
How can you assist in carrying out this work of prevention? First, by organization. If your utility is large enough, you should appoint a small committee, whose duty it is to carry out the accident prevention work. Make it part of your business. If your business is small, then possibly

one man should take it on himself or should be given it as a duty, to see that the work of accident prevention is kept before your men; and if it is a small shop, then it should become the duty of the manager, along with his other duties.

The only way to make accident prevention of real value is to make it part of your job, make it part of the operation of your utility, and if you have a foreman, the foreman is your key. If you had your men putting in poles on the street, and they put them in the wrong way, or if they put a meter in upside down, or do a few things of that kind, you wouldn't be sorry for them or talk to them quite gently, but you would give them hell. But, if a man is unfortunate enough to have an accident, you say: "Well, it is too bad; he is an unlucky chap"; or, if he won't wear his gloves and is injured, because he is not wearing his gauntlets, you again say: "It's too bad," and you pay for the man's foolishness.

I have talked so far in dollars and cents. Here is the real reason of accident prevention: About four weeks ago I was giving a demonstration of resuscitation for the benefit of the nurses in the Toronto General Hospital. A chap was assisting me. Today he is in his grave, as the result of an accident. It was a very difficult one to prevent. Who is going to look after his wife and kiddies? You know what a fix your wife and children would be in if you were knocked out. Just think of that in connection with your own men. I thank you, gentlemen, for your attention.

NOTE—The Committee on Accident Prevention and Health Promotion asked that one session of the convention be given over to it. As a result we have the foregoing addresses by Dr. Hastings and Mr. Maclachlan, which were given during the first afternoon. From the appreciation extended the speakers, the Committee may feel satisfied that its initial efforts are not without results.



Modern Street Lighting from Construction and Apparatus Standpoint.

By M. B. Hastings
A. H. Winter Joyner, Limited

I APPRECIATE the fact that the above subject is one which has been given serious consideration at one time or another by almost each individual present. Much has been written and photographs illustrating ideal installations are many. Your papers committee have requested a joint paper on the subject, and a brief discussion of the construction and apparatus used, falls to the writer. My colleague will, therefore, discuss the subject from an illumination standpoint. After seriously considering the question of costs I decided to say nothing about them because so much depends on local and market conditions. I will also refrain from trying to lay down a set of specifications, but a few remarks covering some of the work I have seen may not be amiss. It is well to bear in mind that the majority of installations need considerable smoothing out after the main system has been completed. Examples such as Bridges, Railway Crossings, Intersections, Bad Curves and Danger Spots always need special attention, independent of anything else. Indeed some of these examples are very difficult to solve.

In general, Street Lighting is either Series or Multiple and in both systems the conductors are installed either underground or overhead. The overhead construction is most familiar and most common, although underground construction is best and is prohibited only on account of its cost. The cost can be very considerably lowered if foresight is used when the road is being made. Fibre conduit can be installed very cheaply if laid when the curb is being built. The one trench will do for both and in fact concrete equal to the volume of the conduit is saved.

The equipment necessary for a Series System consists of a Constant Current Transformer and Panel Board; or, an Automatic Constant Current Transformer such as the Type R.O. Figure 1 manufactured by the Canadian General Electric Co., Ltd. The Type R.O. can be obtained for Pole Mounting or Man-hole Mounting. The cable of an underground series system should be No. 6 Varnished Cambric Lead Covered, with insulation depending on the Voltage to ground. The Voltage to ground depends entirely on the capacity of the Constant Current Transformer and number of lamps in series. This cable is drawn through fibre conduit, imbedded in concrete, from one pillar to the next. Combination potheads and film cut-outs were common, up to a few years ago; but now a Series Transformer at each pillar is considered best. By the use of a small

Figure 1

Series Transformer at each pillar practically all the good points of both the Series and Multiple Systems can be taken advantage of. The practice of mounting the Series Transformer in the base of the pillar has given way to that of burying it in the ground close to the pillar, Figure 2. So little trouble has been experienced with this type of construction that when the primary cable is properly jointed and wiped and the secondary leads are brought into the pillar the Series Transformer is practically forgotten. A practical scheme is to make use of the packing boxes in which the Series Transformers come and fill with a cheap grade of pitch before permanently covering. Under operating conditions this gives a voltage on the pillar corresponding to the lamp in use, which is comparatively very low, approximately 25 volts in case of a 1000 Candle Power, 20 Amp. lamp.

The Series Transformers have an efficiency of 93 plus per cent., a power factor slightly better than 98.5 per cent. and are made in almost any size desirable, although the standard sizes follow the standard lamp sizes. Where larger lamps are contemplated for future requirements, Series Transformers with a capacity greater than the immediate demands should be used. For instance the Series Transformers on the Sunnyside Boulevard in Toronto are capable of supplying 1000 Candle Power lamps, whereas the present installation consists of 600 Candle Power, 20 Ampere Lamps. This factor is an important one from the standpoint of lower efficiency lamps if such are ever obtainable. Where cheap current is available it seems unnatural to spend good money on high efficiency lamps to save that current. The intensity of illumination on the street should not be sacrificed and the ideal lamp for the purpose would be slightly increased in wattage to make up for the decrease in efficiency. The Series Transformer should have a capacity sufficient to take care of this.

The secondary of the Series Transformer should consist of No. 10, 600 Volt Rubber Insulated Lead Covered

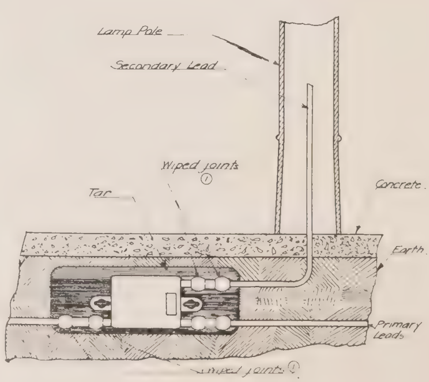


Figure 2

Cable carried through an elbow conduit in the concrete base on which the pillar is mounted. The concrete base should consist of about ¾ of a yard of concrete for the ordinary sized pillar. Anchor bolts varing from ⅝-inch diameter in the case of the small park pillars, to ⅞-inch or 1-inch diameter in the case of the large white-way pillars should be used. The anchor bolts should be approximately 12 inches long, 8 inches of which should be in the concrete. The secondary lead covered leads of the Series Transformer should be long enough to reach the top of the pillar where they should be securely held independent of the socket.

In the case of Underground Multiple Systems all the construction would be practically the same except the cable when 600 Volt Rubber Insulated Lead Covered Cable would be used. The leads to the lamp would be No. 10, 600 Volt Twin Conductor Weatherproof Wire. The drop in voltage, due to long runs of copper conductors is serious, and the size of the copper must be figured out accordingly. This is one of the disadvantages of the Multiple System and the relative cost for copper in per cent. is given on the following chart, Figure 3.

With either the Multiple or Series Systems where crossings are encountered it is best to use a W.I. pipe and protect the end so water cannot get in and freeze. If the expense of lead cable in conduit is too great it is considered good practice to use steel armoured cable. In some Multiple Installations lead covered cable embedded only a few inches under the sidewalk and concreted in, has been used. The cable should be at least 12 inches underground and 6 inches where it is under a concrete sidewalk.

When overhead construction is used the copper wires down the pole should be in conduit where possible. Up to 15 K.V.A. Constant Current

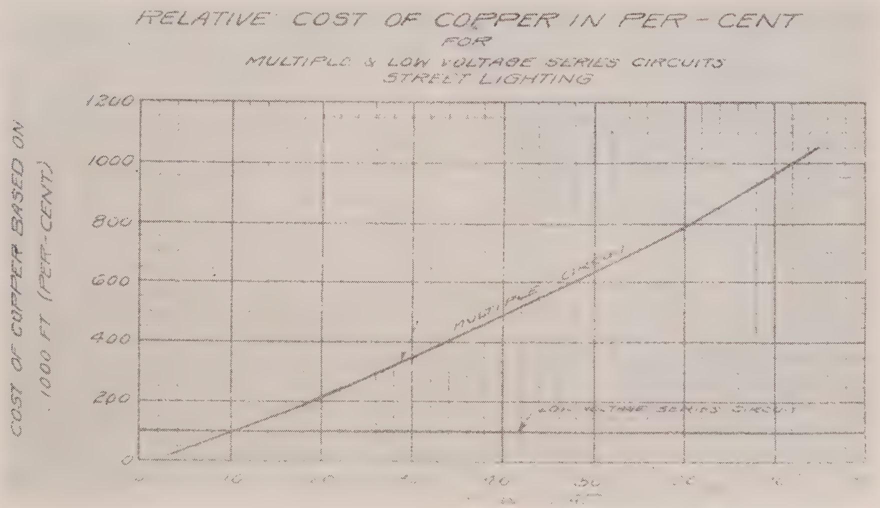


Figure 3.

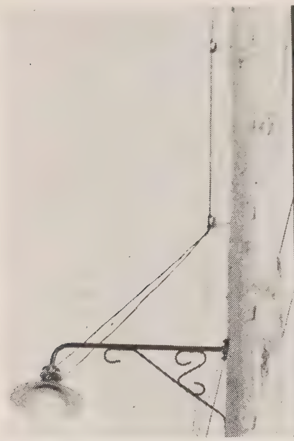


Figure 4

Figure 5

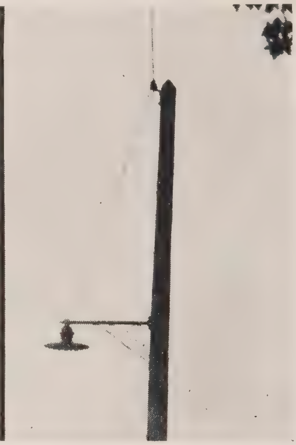


Figure 6

Transformers, where the secondary voltage does not exceed 2,500 Volts, ¾-inch conduit should be used. Between 15 K.V.A. and 25 K.V.A. where the secondary voltage does not exceed 4,000 Volts, 1-inch conduit should be used. Above 25 K.V.A. Constant Current Transformers, the copper should be carried on pin type insulators as shown in Figure 4. The conductor shown is 5 inches from the pole and 9 inches is now advocated, so that the lineman need not come too near to it. Figure 5 shows a Type R.O. Constant Current Transformer mounted on a pole and also the pin type construction carrying leads to the fixture. Unless short poles are used, which permit a maximum of 4 ft. to the fixture, discourage the further use of the construction as shown in Figure 6. The long leads are never too securely fastened to the fixture head and in cases such as this trouble is caused by the continued action of the wind on the leads which eventually produce loose connections. Protective devices are thoroughly recommended. Compression Chamber Multi-Gap Lightning Arrestors are very good on the primary and the Common Horn Gap Lightning Arrestor is best on the secondary where the voltage is of an uncertain quantity.

We have dealt with methods of installations and protective devices and now let us discuss for a moment the control of a system. I am afraid time will not permit a discussion of the maintenance of a system which after all largely depends on the engineer's personal attitude. Control of a system, however, is very important and it is essential that the predetermined schedule for the year be followed. This part of the patrolman's duties are generally neglected. Often as I go up and down the province I see street lights turned on long before time and still burning at eight or nine o'clock in the morning. Such is invariably the case when the system is not equipped with an Automatic Time Switch. Even with time switches the lighting schedule is not followed closely enough. The Time Switch should be set with respect to the schedule at least every week.

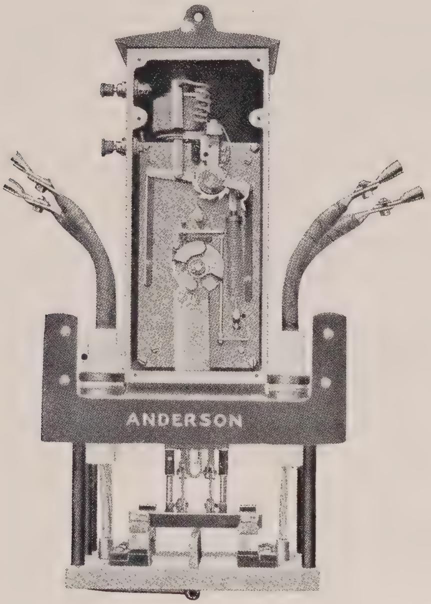


Figure 7

The Anderson Electrically Wound Time Switch is illustrated in Figure 7. It is entirely automatic and will continue to operate as long as it is in good repair. It, however, has to be set periodically according to the lighting schedule. The electrical winding attachment is combined with the Standard Seven Day Clock so there is no danger of the clock stopping on account of power being off for a few hours or days.

One of the most interesting developments in connection with automatic time switches is known as The Season Changing Device for Anderson Electrically Operated Switches. It follows the sun and is illustrated in Figue 8. This is a great step forward in apparatus for controlling the time street lights are on, and a rather detailed description of this new device ought to be worth while and interesting.

When the time switch leaves the factory, the season-changing device has been adjusted for correct operation at the latitude where the switch is to be used, if known. Otherwise it is adjusted to the latitude of Boston—approximately 40 degrees north latitude. The latitude changing is done by lengthening or shortening of the cranks on the two small dials "A." This can be done by first loosening the center screws, when the cranks may be moved in or out, as required. This adjustment is difficult to accomplish, and should not be attempted in the field, but should be done before the switch leaves the factory.

After some time has elapsed between the date of shipment of switch and the time of putting the same in service, it will be necessary to adjust the season-changing device to the correct date when the switch is started to operate. To facilitate this adjustment, the two dials "A" are numbered from one to twelve, indicating the months of the year. These dials "A" may be turned to any position by revolving the screw "B" with the wheel

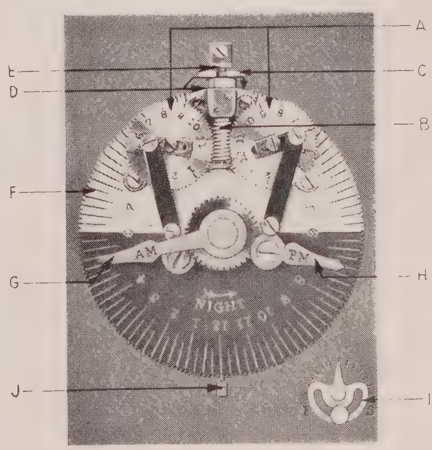


Figure 8

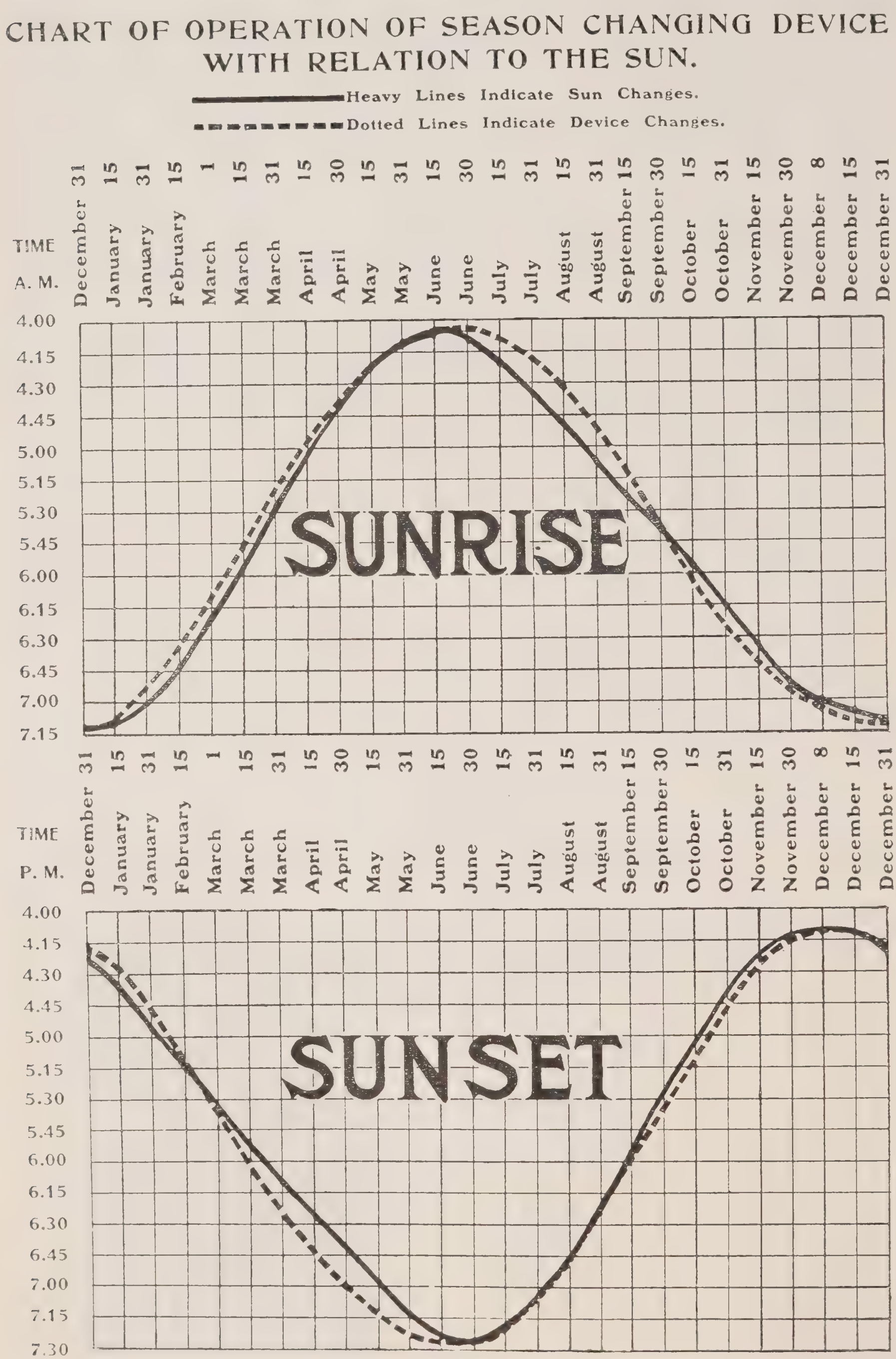


CHART OF OPERATION OF SEASON CHANGING DEVICE WITH RELATION TO THE SUN.
Heavy Lines Indicate Sun Changes.
Dotted Lines Indicate Device Changes.
TIME A. M.
December 31
January 15
January 31
February 15
March 1
March 15
March 31
April 15
April 30
May 15
May 31
June 15
June 30
July 15
July 31
August 15
August 31
September 15
September 30
October 15
October 31
November 15
November 30
December 8
December 15
December 31
4.00
4.15
4.30
4.45
5.00
5.15
5.30
5.45
6.00
6.15
6.30
6.45
7.00
7.15
SUNRISE
TIME P. M.
4.00
4.15
4.30
4.45
5.00
5.15
5.30
5.45
6.00
6.15
6.30
6.45
7.00
7.15
7.30
SUNSET

Figure 9

"C," and should be done as follows:—

First, turn the screw "B" until the pointers "D" are at the numbers on the dials "A" that correspond with the month of the year at the time the device is put in operation. Then turn the wheel "C" to the right one-fifth of a revolution for every day of the month that has passed, previous to the date of setting the device. For instance, if the device is to be set to start operation on September 4th, wheel "C" should be turned until the pointers "D" point to the figure 9 on the dials "A." Then turn wheel "C" to the right four-fifths of a revolution, and the season-changing device will be correctly set for September 4th.

The bearing of the screw "B" is provided with a frictional stop, so that each fifth of a revolution—which represents one day—can be easily detected. The wheel "C" has five teeth, each of which represents one day, which further simplifies this adjustment. Always see that the wheel "C" is left with one slot toward the front, as otherwise the pin "E" that engages the wheel "C" would become disengaged, which would stop the operation of the time-switch. This pin "E" also acts as a pointer for indicating on the 24-hour dial the time of day. As part of the dial "F" is covered by the season-changing device, an additional pointer "J" is placed at the lower edge of the dial "F" to make easy the proper setting at correct time, of the time switch. To set the clock at the correct time TURN THE 24-HOUR DIAL TO THE LEFT AS INDICATED BY THE ARROW.

The two pointers "G" and "H" are for setting the switch at the desired time of operation, and are frictionally connected to the levers that operate them, so that they can be moved to the desired position easily with the fingers. One of these pointers is marked "A.M." and the other "P.M." to indicate which should be used for morning and evening operation.

The regulating lever "I" is for regulating the clock. To do this, loosen the thumbscrew and move the pointer either towards "F" (fast) or "S" (slow), as desired.

When correctly set in accordance with the above directions, the instrument will follow the sunrise and sunset with a maximum error of about fifteen minutes from sunrise on August 15th and a similar error of fifteen minutes for sunset on May 15th, but will be practically correct on December 15th and June 15th, as shown in Figure 9.

Modern Street Lighting from Illumination Standpoint

By R. M. Love,

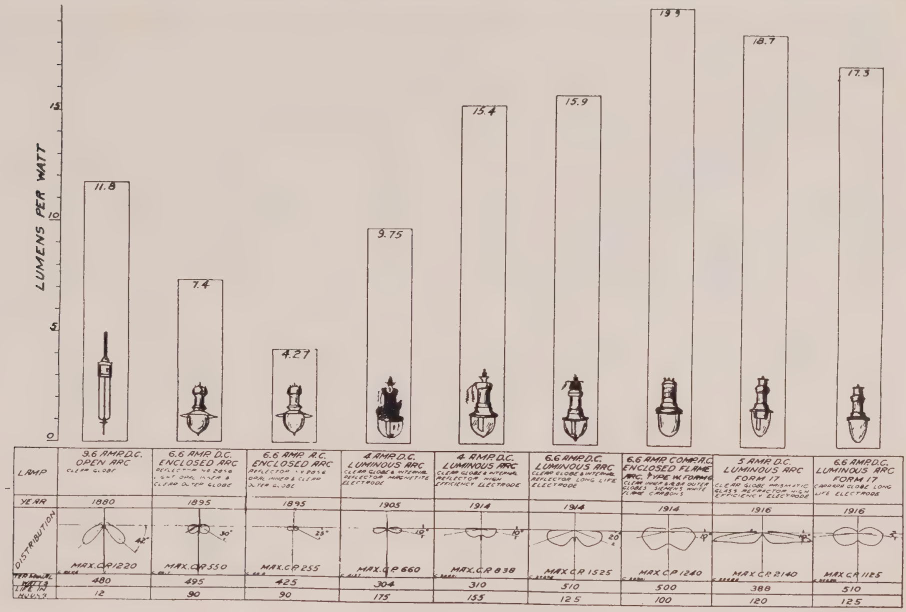
Street Lighting Specialist, Canadian General Electric Co. Limited

THE subject assigned for this paper—"Modern Street Lightning from an illumination Standpoint," is somewhat of a broad subject it every detail was to be gone into fully. It is therefore, the intention of outlining briefly the general principles of obtaining the desired street illumination of the different sections of Cities and Towns.

Before going into the matter it might be interesting to bring before you the changes that have taken place in the last ten or twelve years. Of course if we go back far enough we will find the first street lamps being nothing more than oil burners. Then we come to the gas lamps; first just the ordinary gas flame, then an improvement on this was made by utilizing the gas mantle. This type of lighting can still be seen in parts of the States, particularly around Boston, where the Welsbach mantle naptha lamps are in use by the hundred. The gas lamps have to be turned on individuallly by the lamp lighter and so as to complete his rounds before dark, must start quite early in the afternoon so as to have the lamps lit by dark, consequently you will find a large number of lamps burning long before it ever gets even dusk. The same thing happens in the morning, some lamps lighting till near noon. It can plainly be seen with such a system there is an entire disregard for the conservation of natural resources.

Then with the common use of electricty came the Arc lamps; the first being the 9.6 D.C. Open Arc Lamp dating around 1880. From that time on up to the present day, improvements were made in conjunction with Arcs as shown graphically on the first slide, until to-day we have the Metallic Arc Luminous Lamp. On the graphical chart shown, improvements are illustrated up to 1916, since that time the Metallic Arc Lamp has had still more improvements. Its mechanism has been changed materially making it less complicated. The Metallic electrodes used with it have been improved both in efficiency and life; efficiency increased, approximately, from 50 to 75 per cent. and life of the electrodes increased as much as 100 to 150 per cent., thus reducing maintenance considerably.

Owing to the complications in mechanism of an Arc Lamp of any kind, which really requires skilled workmen to look after, and the development in the incandescent lamp during the period I have just passed over, it was deemed advisable to utilize the incandescent lamp for street lighting, particularly in the small Towns and Countries outside of the United States, where, owing to supply parts for Arc lamps having to be brought in from a foreign country



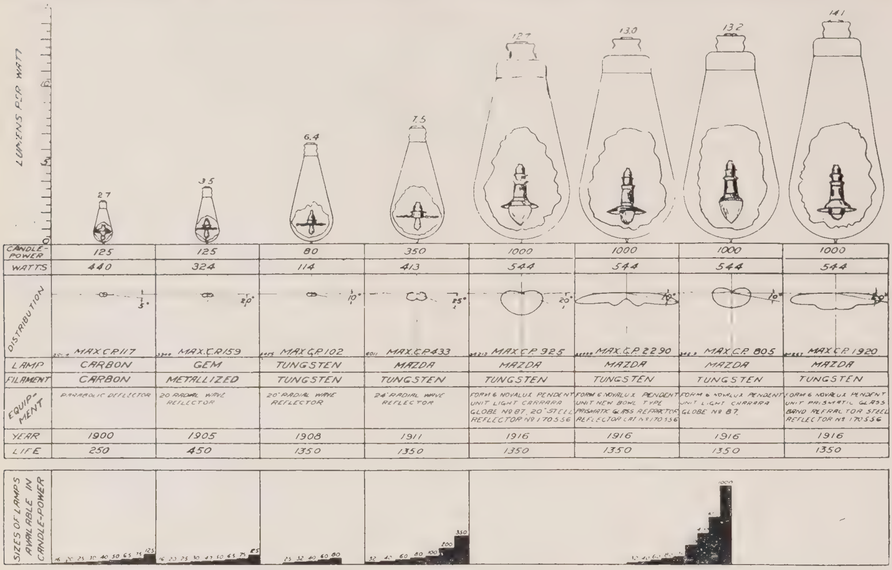
Advances in Efficiency of Series Arc Lamps, 1880-1916

Slide No. 1

increased maintenance considerably. However, prior to 1907 there was little or no advancement made with the incandescent lightning until the Tungsten filament lamp was introduced. From that date up to the present day wonderful improvements have been made in the development of the incandescent lamp. This is graphically shown in the next slide.

Up to 1914 incandescent street lighting was confined to smaller towns and out-lying districts where high intensity was not needed. There was a great number of cities utilized incandescent lamps for lighting their downtown sections by using the three or five light clusters. In fact this system was extremely popular for a period in both Canada and the United States. It was the only means of increasing the intensity previous to the development of the large, high efficiency incandescent lamps. These clusters were considered ornamental and efficient at the time; then came the development of the large gas filled high efficiency lamps ranging now up to 1,500 C.P. in the series type for street lighting. With this advancement the day for cluster lighting came to an end; when we compared its ornamental features with a stately single unit it had no comparison; when maintenance was considered, the single unit naturally was by far the most economical. When we take into account efficiency the single lamp is far the more efficient than a number of lamps with the same amount of candle power or wattage. There is also less glass-area to absorb light and no arms to obstruct light. This is clearly shown on slide No. 3

This brings us up to the present day when we can utilize a modern efficient Arc lamp which is still used extensively in the States and some of



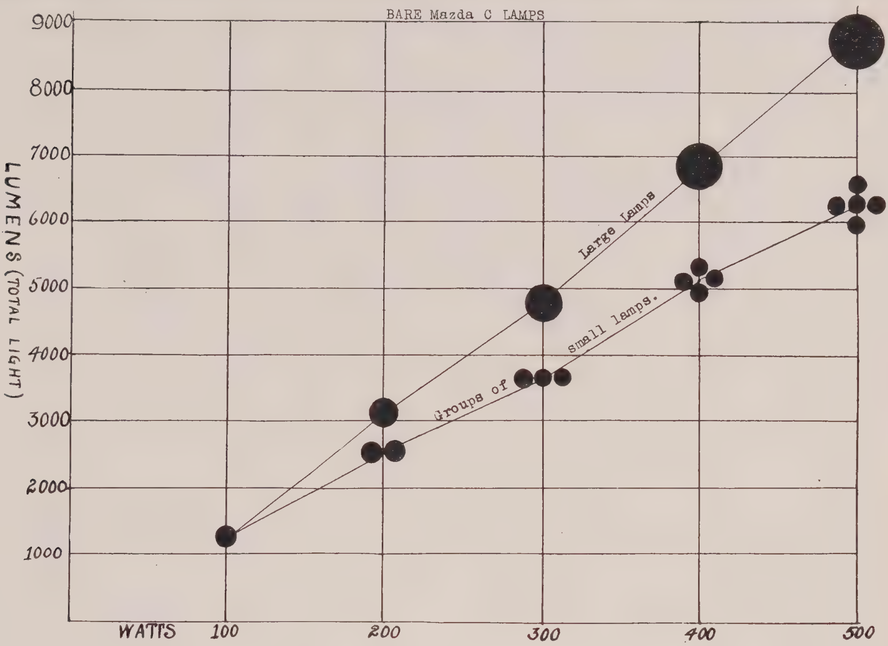
Advances in Efficiency of Series Incandescent Lamps, 1900-1916

Slide No. 2

the larger Cities in Canada or a high efficient incandescent lamp for all phases of street lighting.

To illustrate the problem we are confronted with when considering street lighting, we will assume we have a City of about 75 to 100,000 of a population. This will then cover most every phase. It can be divided off in the following sections:—Main Down Town Section (White-way lighting); Secondary Business Streets; Main Residential Districts, Boulevards and Park-ways; Suburbs; Highways leading out of City. We will first take the White-way District. This being the main business district it calls for ornamental lighting. The Type of Unit and Standards to be chosen, when possible, should be of such a design so as to harmonize with the architecture of the buildings. Then intensity of illumination should be such as to flood the street with light, having an intensity of from .25 to 1 ft. candle, according to the density of traffic. Height of units ranging from 15 to 18 and in some cases 20 to 25 ft. Spacing 100 ft. opposite-utilizing 1,000 C.P. or 1,500 C.P. lamps.

Where the Main street is built up of buildings of fine architectural quality it is usual to allow the light to flood the sides of the building as well as the street surface, a large portion of the light striking the building fronts will be reflected back to the street surface; this varying according to the nature of the building. Where the buildings are not high and it is considered advisable not to illuminate them to a high intensity, refracting glassware should be utilized in the Unit and thereby affording longer spacing. If the Unit is utilized without refractors, care should be taken to choose the proper glassware so as to obtain the required amount of diffusion and at the same time not lose



Slide No. 3

·0 to 50 per cent. of the light in transmitting it through the glass. This I might say is a study of to-day for the illuminating engineer. Within the last year or so new glassware has been developed, designed with minute proturbances and depressions on the outer surface. This diffuses the light by breaking it up, also by adding an outer flashing of opal. Here you have an effect never obtained before in street lighting as it adds a pleasing sparkle to the light source.

Where refracting glassware is necessary a dome refractor can be utilized in this new type of glassware without casting a shadow on the globe owing to the light source being broken up by the rippling on the glass. The effect of a refractor is shown on slide 4, the refractor being nothing more than two glass bowls or domes placed together. The inner surfaces being cut into prisms so as to direct the light downward at the 10 degree angle below the horizontal.

The results obtained from up-to-date White-way lighting are as follows:—

The Cosmopolitan atmosphere and dignified effect of the standards by day as well as night.

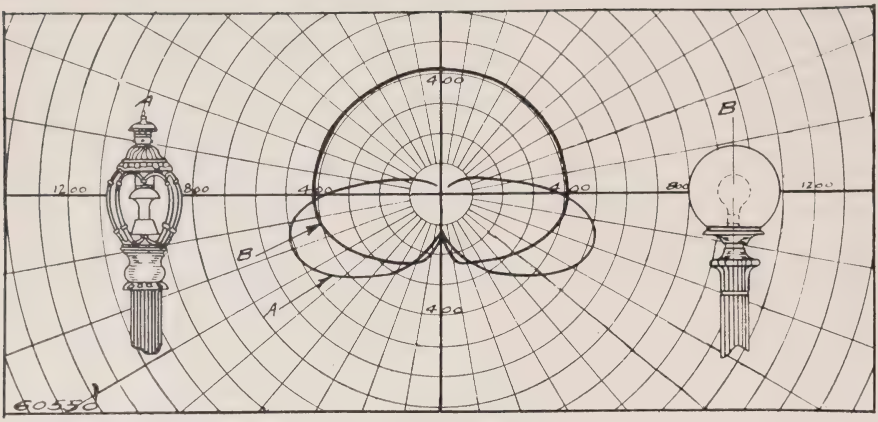
The minimized window reflection on account of height of Units.

High intensity and uniformity of distribution of light on street.

People attracted down town at night, aiding the merchants' to display their goods.

An impression planted in the minds of visitors to City which will never be forgotten.

Secondary Business Streets, utilizing a similar design but perhaps a small unit and lamp, refracting glassware and longer spacing is recom-



Slide No. 4

mended. This will still maintain an even distribution but with a lower intensity than that of the White Way. The mounting height should be maintained not lower than 15 feet high, average hor. illumination should be from .10 to .25 foot candles, spacing 125 to 150.

Main Residential Streets, Boulevards and Parkways; when we come to consider this phase a very difficult problem usually confronts us, mainly to the trees which we have on our residential streets and boulevards. We must not do away with the trees of course, as really having the trees is the only way of taking away the business air and endeavoring to obtain the boulevard effect, thus making desirable residential quarters. The trees also serve as a shade as well as beautifying. However, if these streets are to be illuminated to the degree that is necessary, taking into consideration the traffic that is on them, which is heaviest in the evening, it is important to at least endeavor to keep the shade trees well trimmed. It will also be necessary to keep the branches well trimmed to a height at least 12 to 13 feet above the ground. Of course, this will not be necessary on the younger trees.

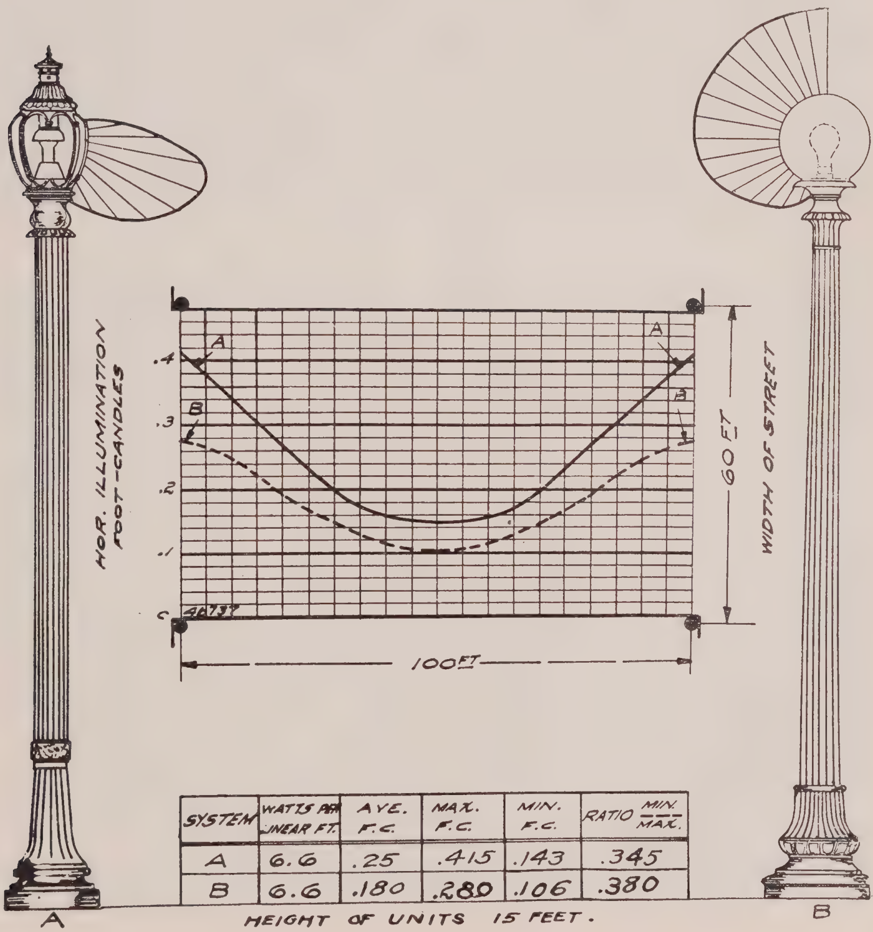
Where an ornamental system is to be installed such as you find in some of the higher class districts where the ratepayers are willing to pay the cost, which is really small, spread over a number of years, also along driveways and parkways, it was usually found in the past that a short post anywhere from 9 to 10 feet was used, utilizing a ball globe. Short spacing between units had to be used and even at that the intensity on the road surface was very low, as over 50 per cent. of the light was lost in the trees.

To accomplish the desired effect the units should be mounted at least 12½ to 13 feet high, in fact if the trees are not too thick it is desirable to mount them as high as 15 feet. The spacing can be 100 to 200 feet, on the staggered or opposite layout, providing the correct glassware is used and either a 400 or 600 candle power lamp utilized. Here we have an ideal application for refracting glassware, in fact to obtain illumination on the road surface so as to make driving entirely safe, refract-

ing glassware is absolutely necessary. The type of unit to be chosen will depend on the amount of money available.

The lantern type of unit is becoming very popular to-day for all classes of lighting, but especially for driveways and residential quarters. Its initial cost will be slightly higher than that of the usual glass globe but its maintenance will be considerably lower and from an architectural point of view it suits the surroundings. The dome refractor can be readily used in conjunction with the lantern providing rippled or stippled glass panels are used. This glass can have a slight flashing of opal in it without nulifying the effect of the refractor. However if it contains too much opal the light source will be given a yellow appearance which is not altogether desirable. The whiter the light the more pleasing and efficient.

If a glass globe is to be utilized it should be made up of glass which has diffusing qualities in it and at the same time designed so as to ac-



SYSTEM	WATTS PER LINEAR FT.	AVE. F.C.	MAX. F.C.	MIN. F.C.	RATIO MIN./MAX.
A	6.6	.25	.415	.143	.345
B	6.6	.180	.280	.106	.380

Slide No. 5

commodate a refractor. To accomplish this, stippled or rippled glass should be used, otherwise the effect of the refractor will be killed and a bad shadow will be cast on the globe. The design of standard should be neat and simple, along slender lines.

Where there is an over-head system to be used, bracket type units can be neatly arranged suspended from existing pole lines or centre span suspension can be utilized, where trees have grown up on both sides almost forming an arch-way across the roadway, as can be found in many cities. This is really the only efficient means of obtaining light on the roadway. Here also refractor is absolutely necessary.

As we get out in the suburbs wider spacing can be utilized, 200 to 300 feet or if the blocks are not much longer than this, units can be suspended at each intersection. Here also we can readily see the importance of refracting glassware. Still another type of lighting for suburbs is the ordinary bracket and porcelain enameled reflector. This type of lighting has had its advancements also; the reflector being made with a longer neck lowering the reflecting surface nearer the filament of the lamp.

When we come to the Highway we once again have a problem which has baffled the illuminating engineer until within the last year or so. Up to the present time here in Canada we have not bothered with the lighting of our highways only for a half mile or so leading in and out of our towns and cities, and this will be found in most cases, very inefficient lighting, usually an 80 or 100 C.P. lamp with an enamel reflector spaced 400 and 500 feet apart. The problem that was to be met was this; a suitable luminaire that would throw the light only on the road surface, utilizing long spacing and a moderately small lamp, otherwise owing to cost it would be impracticable to illuminate the highways.

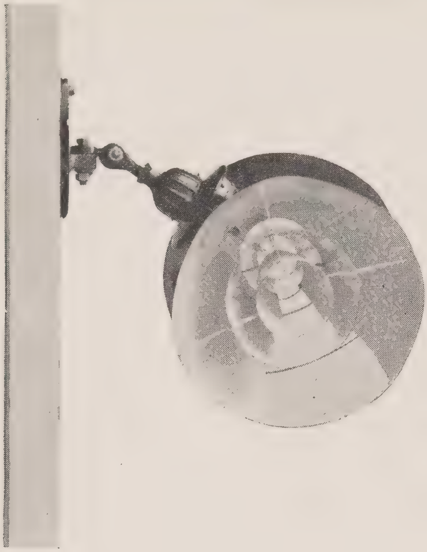
This condition is now being met with the new Parabolic Highway Lighting Unit. This is absolutely the latest addition to street lighting. This unit consists of small reflector screens typically shaped and assembled that they do the work of an ordinary 15 foot reflector. The light from this unit is directed only along the road surface. This unit should be mounted 30 feet high, which is usually practicable on existing pole lines along our highways and a 250 c.p. lamp utilized. The units should be spaced 300 feet apart for the main highways where traffic is heavy and on secondary highways this can be increased to as long as 600 feet still maintaining better illumination on road than that of the usual reflector.

An idea can be had by looking at the photometric curve of the unit as to the spread of light. You will notice at the ten degree angle below the horizontal the curve reaches over 4,000 c.p. The diagram of direction of light rays emitted from the Highway Unit is also interesting and gives an idea how this wonderful distribution of light is accomplished.

From the night views shown and the demonstration along the River Road which I would suggest be inspected by all, one can appreciate the value of this unit. Now that our highways are travelled on to such an

Sunnyside Boulevard, Toronto.

Sunnyside Boulevard, Toronto.



Parabolic Nest Highway Lighting Unit.

extent the importance of lighting them can no doubt be appreciated by all.

The main problem which we are confronted with in regard to highway lighting is, who is going to pay for it? The towns and cities will not extend their lighting outside their limits, in most cases, and it therefore looks as if it is up to the Department of Highways in our Government to take care of this lighting. In the United States steps have been taken in this respect. The New York State has just passed a bill providing for lighting the highways in the cost of repairing and construction of highways. Other States are doing the same thing. This seems to be the only solution and when a comparison of the cost and maintenance of highways is made with the cost and maintenance of lighting, the lighting end is so small that it is really only a drop in the bucket.

When we consider the number of accidents at night along our highways it goes to show that the sooner we come to the lighting of them the better for all concerned.

Regarding the system recommended for highway lighting, I would like to say a few words on this before leaving the subject. It is recommended that a series system be used whenever possible. The units can be fed from pole type Constant Current Transformers which can be operated by time switches. It will be found that the maintenance of a series system will be lower than that of a multiple system, as the life of the series lamp is usually longer than that of a multiple system. However if this type of lighting is to be utilized where a multiple system is already in use, the unit can be very successfully operated by using a 200 watt multiple lamp.

In conclusion I would like to leave you with this message: When installing a street lighting system you are spending the peoples' money on something they can see results from every day. Is it not worth consideration, to see that they get the most efficient system for the amount of money expended? I have also pointed out to you some of the improvements that have been brought about in street lighting apparatus to obtain maximum illumination at least cost. Now I leave it to you to decide,—should not the people get the benefit of the latest developments? The average ratepayer takes the word of the engineer as to what is the most efficient system and type of unit to be utilized. Therefore, it is the duty of every municipal engineer particularly, to make a careful study of this matter when he has a street lighting problem on his hands.

DISCUSSION

Mr. R. H. Martindale (Sudbury)—It has occurred to me, in connection with Mr. Hasting's paper, as to the use of series transformers, is there any detrimental effect on the transformer when a lamp burns out, or, in other words, when the secondary circuit falls down?

Mr. Hastings—The transformers are designed to stand open circuit conditions.

Mr. Martindale—If the circuit remains open for some time, will there be any detrimental result?

Mr. Hastings—No, that has been pretty well taken care of. That was one of the first difficulties which was run into.

Mr. Martindale—As to mounting of the large candle power incandescent units on a bracket on a trolley pole, is there any objection to that owing to vibration? Will vibration affect them?

Mr. Hastings—When the trolley pole is placed in the centre of the street, with an arm coming out to the trolley wire, it is objectionable, because when every time a street car passes and the trolley pole hits the arm there is considerable jar on the pole, and trolley poles springing off the wire often catch the units or the rope coming down. But where the trolley poles have been placed at the sides of the street, there is very little vibration of the poles from the span wires holding the trolley wires.

Mr. H. F. Shearer (Welland)—I am sure we all greatly appreciate the way these gentlemen have gone into their subject. I have one matter in my mind, as to whether it would be advisable to change from a multiple system to a series system. Has there been any determination as to at what point such a change should be made? With the time switch, as we have had it demonstrated this morning, there is no doubt that the series system in the sparsely settled or rural districts, could be operated. Has there been any determination as to where the point would come when it would be advisable to make the change from the multiple system to a series system?

Mr. Hastings—The point where to leave off a multiple and begin a series system has always been a ticklish one. I do not know how to answer the question to Mr. Shearer's satisfaction. Perhaps Mr. Lang, if he is here, can answer it better than anybody else. He does more determining of what kind of system should be used than any one else of whom I know.

There is no doubt where you have long lines, that the series system is quite the proper installation to put in. The large installations of over one hundred fixtures, certainly is reaching the point where you gain the efficiency which is characteristic of series systems. With an extremely small system, such as is met with in a number of municipalities in Ontario, it is just doubtful whether a series system is an advantage or not; but where you go up to anywhere over two hundred fixtures, I would say a series system would work out to ad-

vantage. I do not not know that that answers Mr. Shearer's question, but the point at present is a puzzle.

Mr. J. J. Heeg (Guelph)—I would like to ask the name of the Amalgam of which Mr. Love spoke, and where it may be got?

Mr. Love—It is Wyatt's Liquid Amalgam and the address is 225 Richmond Street West, Toronto.

Mr. G. L. Alexander (General Electric Co.)—I might state, Mr. President, with respect to the limitation of the series system, as against the multiple, that there is hardly any limitation.

Some Peculiar Phases of Allocation of Charges for Municipal Electrical Utilities

By R. C. McCOLLUM

Auditor Municipal Accounts, H.E.P.C. of Ontario

WHEN the Uniform Accounting System for Municipal Electric Utilities was issued in 1912 and revised in 1915 it was essentially an adaptation of the accounting systems which had been practically standardized by the Interstate Commerce Commission of the United States and by the most prominent of the Public Utility Commissions at that time, notably New York and Wisconsin.

These systems came into being simultaneously with the demand for some sort of control over the rates charged by private companies for service dependent to some extent on franchises granting the right to use the public streets and the practical elimination of competition, a condition lending itself very readily to extortion and discrimination, with no right of redress or method of relief.

Laws were passed in various States and by the Federal Government at Washington placing some measure of control of rates in the hands of Public Utility Commissions, which were empowered to hear evidence, study operating reports and statistics and finally order rate revisions.

The first essential to the intelligent operation of such a Commission was a standard or uniform accounting system by which balance sheets and operating reports of operating companies could be compared, and the improper loading of expenses more readily detected, and the result was the evolution of a uniform accounting system so clearly and precisely outlining a reasonable and rational practice, and so closely adhering to the unalterable laws of economics, that except in the

choice of language all of the accounting systems of which I have knowledge are practically similar and interchangeable.

It will be noted from the above that the Uniform Accounting Systems were evolved primarily for the protection of the consumers rather than the owners of the utilities concerned, and it was but logical that the Hydro-Electric Power Commission, acting as the agent or trustee for the municipalities and through them, the consumers, should have adopted the Accounting System as already developed for privately owned utilities, making such modifications as were necessary to eliminate returns on capital stock and at the same time provide for the amortization of the plant cost by means of the annual principal and sinking fund payments on debentures.

However, the working value of an accounting system, embodying as it does the best collective judgment of many practical and experienced engineers and accountants, was quickly realized by all large public service companies, who no doubt would have adopted some uniform accounting system for their own protection long ago, quite regardless of governmental regulations.

Most of you are already familiar with the Commission's "Uniform Accounting for Municipal Electric Utilities" and the method followed of dividing it into three sections to permit a practical application of identical principles to large, medium and small municipalities, and while in each case the text is plain and understandable to the average reader, its use presupposes a working knowledge of practical bookkeeping. As in everything else in life, knowing how a thing should be done, and being able to do it, are two very different things.

The function of any accounting system is to reflect or mirror in a form so condensed that it will make a clear-cut impression on the human mind, the cost of a plant, the money value of same, the financial result of operation of the plant for definite periods and the cumulative result of operation to date. All effective accounting systems must do this, and refinements or subdivisions are added according to the desire of the management for detailed analysis.

As an illustration, a man might build himself a house, paying all the bills as they came in from a special bank account, and when the house is finished his bank balance will show the cost to have been, say, $5,000.00. This may answer all his needs for the present, but if he undertakes to build another, he cannot plan as intelligently or efficiently as his neighbor who knows just how much of his $5,000.00 house is represented by excavation, masonry, rough lumber, finishing lumber, hardwood floors, roofing, heating, plumbing and painting, etc., nor can the young couple who face embarrassment in meeting a monthly living expense of $125.00 out of a $100.00 income set their finances in order until their expenses are so analyzed that essentials and luxuries can be definitely determined and retrenchment intelligently planned. The same rules are equally applicable to big business,—we should *know*, and Bacon's observation that "a little knowledge is a dangerous thing" is as truly applicable

to bookkeeping or accounting as to everything else.

Briefly stated, all expenditures fall naturally into four principal divisions:

1. Plant or Capital;
2. Maintenance and Renewals;
3. Operation and Administration;
4. Interest and Debenture Payments.

In addition to the actual money expenditures enumerated above, a provision is made for providing revenue from the date a plant becomes alive to replace or restore each unit making up the plant, when it becomes economically irreparable, and in actual practice this has been assumed to include obsolescence as well.

The general rule governing the allocation of capital is simple,—embracing all items having an expectant life of more than one year, and the rule governing proper maintenance is equally simple at first, but the complications which finally develop in the handling of the accounts when a distribution system is being rebuilt to accommodate a change in load, and when the maintenance accounts are taking care of actual renewals or replacements, can be realized only by those actually in charge of such work.

I said above that the accounts should show the plant cost and its money value. These are by no means synonomous things, but it is a more or less neglected factor in many private companies as well as in practically all municipal utilities, and the relations between the two in theory are continually in a state of flux. Tangible values should always be segregated from intangibles, but the total of the two should show the total outlay on capital. Plants may be abandoned, by reason of obsolescence or change in load, and where this is done, the cost should be taken out of active capital and carried in an obsolescent plant account. Pole lines may be taken down, and even if the material is salvaged, the labor erecting and demolishing is no longer tangible property, and except in unusual cases where there is special revenue to set against such cost, the amount should be still carried as intangible capital. The charging of such items to expense is unfair to the consumers of that year, destroys the continuity of the operating record, and especially in municipal systems where rates are yearly adjusted on a cost basis is demoralizing.

We will consider, first, the case of a distribution system designed to provide for a normal balanced lighting and power load, which after a few year's use, in order to provide for several large power customers, has to be practically rebuilt. Granting that most of the material can be used, all of the labor in the original construction and in dismantling no longer represent value, and should in theory be eliminated from tangible capital, and other material, such as crossarms, while still good for some year's service, is discarded as not justifying the labor of replacing for its short remaining life.

Under no circumstances can we justify a maintenance charge against revenue of more than twelve months' ordinary wear and tear when full theoretical depreciation is also being provided for, so that it would appear quite logical and about the only practicable plan to allow the original la-

bor and overhead to remain in capital, capitalize so much of the new material and labor as went to increase the capacity of the plant, as nearly as can be determined, and charge the balance to the Depreciation Reserve, even up to the point of its entire depletion. Such a plant being practically new, can stand in the balance sheet without much accumulated reserve and not be subject to particular criticism. In actual practice, however, it will be found that no hard and fast rule can be adhered to, and as is so often the case, good common sense must govern.

Renewals—Under the classification the consumers are required to provide out of revenue for the current maintenance of the plant, and also for the ultimate replacement of each unit. An average rate has been set for this based on the average economic life of the various units of the plant, but so far no account has been taken of the increased life due to maintenance. For instance, a meter having a life expectancy of twenty years is rejuvenated periodically by cleaning, oiling and possibly the replacing of jewels and coils, so that its actual life far exceeds the estimate. A pole taken into account on a twelve year life basis may, and in cities and towns with proper drainage, usually does complete a life of more than double that time, or it may be cut and reset in a different location with an additional life of many years.

In a general way plant life expectancy on which depreciation rates are computed, is based on evidence of so-called experts before Public Utility Commissions in rate adjustment hearings, when it is to the interest of the private companies to justify high rates by proving rapid depreciation of plant. We have probably all observed in recent hearings in which we have more than a passing interest, that any contention can be proven by the testimony of experts. At any event, the burden of proof that the figures submitted by the experts were extravagant has always been on the Commissions, with the result that they usually allowed the benefit of the doubt, and the official records may be reasonably considered as ultra conservative.

The result of all these conditions is that our authorized depreciation rates normally build up an adequate reserve long before the time when actual replacement becomes necessary, and to prevent an unfair loading of expense against revenue, the actual maintenance expenditures should be carefully scrutinized, and that part of the expenditure which extends the life of the units affected should be charged against the Reserve, leaving in maintenance only a normal twelve months' wear and tear. This also is largely a matter of good judgment and common sense, taking the conservative position in case of doubt.

There is another factor which has a very important bearing on this matter in the average Hydro Municipality, excepting only the very largest and smallest places, and that is that ordinarily all extensions to plant and all renewals of same are made without labor charge and include only the bare cost of the material. The reason for this is that in the average municipality there is an irreducible minimum of staff who are charged to the

third general heading, "Operation and Administration," and the normal extensions to the plant and maintenance work are taken care of incidentally without additional expense by the operating staff, who are indispensible regardless of such work. As a matter of fact, excepting only the very large and very small places where men are engaged specifically for this work, there has been practically no labor incorporated in the cost of additions which have been made to the municipal plants since the systems were first made alive.

Assuming that on the average about 50% of the cost of the original plant consists of labor, it follows that as no additional labor is required when replacement is made, the ordinary depreciation rate so far as it applies to the original plant, is about twice the actual requirement, or what it need be.

In the operation of an electric utility or a telephone system, made up of a large number of relatively small units, there is a point beyond which actual depreciation cannot go and the plant give satisfactory service. Renewals of small parts, automatically charged to maintenance, and the constant additions of new material in extensions, tend to retard, and at some point definitely arrest the progress of depreciation. In a recent hearing where the rates of the New York Telephone Company were under revision the New York Public Utility Commission, 1st Division, a body whose judgment will be respected by all other similar bodies, recently ruled that thirty per cent. of the tangible depreciable plant value was the maximum depreciation reserve that could be justified in a balance sheet. This closely follows the evidence given in the recent hearing of the application of the Bell Telephone Company at Ottawa for an increase in rates, when their application was refused by the Dominion Railway Board.

In many Hydro municipalities the accumulation of depreciation reserve in less than ten years' operation already approximates this percentage, and if we add the free surplus, frequently exceeds it, and it is altogether likely that before long the depreciation rates will either be revised downwards or a maximum fixed which will have the same effect.

In one important essential the requirements of the accounting systems governing the operation of the Hydro-Electric Power Commission and the Hydro utilities differ from those controlling private companies in that they include as an operating charge the principal and sinking fund payments on the debentures, which a private company never does, and remember, when making comparisons with prices quoted by private companies, that you are automatically acquiring complete ownership of the generation, transmission and distribution system. In many municipalities a debt free local plant is already in sight and the balance is a matter of mathematical calculation. There is some satisfaction in planning such a heritage for our children.

The accounting system is in its way as essential to the success of the Hydro as the supply of energy, because its economic success is dependent on an accurate knowledge of what is taking place. Every Commission-

er, Manager, Secretary or Representative of a Hydro utility in any capacity should have a general understanding of the principles of the accounting system, and should be so familiar with the municipal section of the annual report that he can obtain from it without effort, any knowledge he requires for his own information or for the benefit of his friends.

If you have a reasonable question about your operation, the answer should be in this book. If it is not, make it your business to find out why.

DISCUSSION

Mr. G. J. Mickler (H.E.P.C. of Ont.)—In my experience as an associate of Mr. McCollum installing accounting systems and checking operating and construction figures, it has been brought home to me many times that too few people entrusted with the making of accounting records are fully informed on the proper distribution of expenditures.

To some, so long as there is money in the bank to pay the bills, operating expenses would consist of capital, operation, maintenance, renewals and everything else constituting a money payment, regardless of its effect on the operating results of the utility.

To others, the fact that an overdraft is being carried at the bank, means that no capital expenditures can be made, and that the utility is financially unsound. While to others, the line drawn between what is truly capital, or renewal of capital or operating expenses is so vague, due to lack of study of the principles involved, that they cannot distinguish between them, and the result is their bookkeeping figures do not reflect the true condition either of the value of the plant in operation or of their operating costs.

To my mind too much study cannot be given to the principles underlying the allocation of charges for capital, renewals or operation, especially in the larger municipalities where the expenditures are heavy, where plant is being changed or renewed continually and where the operating results can be materially affected by errors in judgment.

In larger municipalities the engineers entrusted with the work of construction of plant and its replacement should be brought in touch periodically with the accounting officials, the importance of the proper allocation of expenditures discussed and a definite policy outlined which all can follow without fear of error.

At present we know that what looks to the accountant like legitimate capital is truly replacement due to obsolescence or deterioration of the replaced unit, and that what looks like a replacement is truly maintenance due to the conditions governing the case being considered. This is due to the accountants not having the perspective of the engineer, and visualizing the effect of expenditure on the plant capacity or value. Similiarly the engineer, not having the account-

ing point of view, frequently forgets the effect of his judgment on the book values of plant. He cannot keep in mind the ultimate effect on depreciation, reserve and profit and loss accounts, as he does not know how these different accounts are really made up and how they function in an accounting system.

As stated by Mr. McCollum we cannot justify a maintenance charge against revenue, of more than twelve months ordinary wear and tear, when full theoretical depreciation is being provided. The charging to operation of renewals one year while none may be made the following year creates an unbalance which the present system of rates cannot combat, and since the rates are based on service at cost of operation and maintenance, only true operating costs dare be considered as an expense, to keep them within bounds.

We have been frequently criticized for making charges to depreciation reserve account when the effect has been to increase the operating surplus, on the argument that we must make a system pay, but such is not the reasn for the decisions to do what was done. Our endeavor is always to present in as true a light as possible the operating conditions of a utility regardless of the answer.

As stated before all interested in the allocation of charges to the various principal divisions of expenditures should co-operate to make sure that the proper treatment has been given to every dollar spent.

Mr. J. J. Heeg (Guelph)—Mr. President and gentlemen: I would like to say that Mr. McCollum's paper contains something which is worth while. We possibly do not appreciate it, at first glance; but it makes you think. For instance, the small municipalities who cannot have an accountant or a bookkeeper with the gang of linemen, to charge up every pin and cross-arm which may be used, have the question arise whether they are making a fair charge or just taking the list of material as it comes in and then dividing it in the office the best way they know how. Many of us would like to know how that should be done.

There is another question. We are all at times up against the case of pavements. Streets which are being paved with permanent roads in a good many cases require the pole line moved across the street; and in that case the users of light and power have to absorb the charge, while I think it should be charged up to the new roads. Those are two things which I thought I should mention, because they may bring out some discussion which would help to settle on something as a standard.

Mr. O. M. Perry (Windsor)—The point in which at present I am most interested is, when the capacity of the line is increased, how the charges shall be made. Down in Windsor if we change a fifteen kilowatt transformer and put up a twenty-five kilowatt transformer in its place, we have increased the capacity of the system, and we have been charging, roughly, one-half to maintenance and the other half to capital account. It appears that we have been wrong in doing this, but, if we have erred, I think it is an error on the proper side.

I would like to ask Mr. McCollum how he would apportion the charges in a case like that—how much should be charged to capital account and how much to maintenance.

Mr. R. H. Martindale (Sudbury)—Mr. Chairman and gentlemen: Mr. Heeg raised a point on which I would like to have the opinion of the auditors; that is, when improvements are being undertaken on the street and the pole lines are already erected. In the event of some street improvement being brought along, necessitating the moving of our pole lines, should the electric light plant bear the cost of moving that line, or should the cost of it be charged to the improvement? What department should bear the cost?

Mr. G. F. Drewry (H. E. P. C. of Ontario)—The question of the amount of depreciation which should be set aside is set down by one authority at thirty per cent of the tangible, depreciable plant. Just when does he understand that thirty per cent should be reached and should it be maintained at thirty per cent thereafter, or should it fluctuate? Of course it is possible, by setting aside a certain percentage to maintain it at thirty per cent. thereafter. Is this held in reserve for eventualities which are unforeseen, or is it to take care of the time when it might be presumed that the plant would all be worn out, and it would then be needed to be spent, and consequently there would be no reserve, and you would start to follow another cycle?

He speaks of wear and tear and says that under no circumstances can we justify a maintenance charge against revenue of more than twelve months' ordinary wear and tear. While the statement, of course, is simple enough, will he agree with you and me on what is ordinary wear and tear? As a plant gets older, it must cost more to maintain it, and the plant depreciates more rapidly as its gets older. These phases of it are hard to figure out in a good arithmetic way. You can use common sense, possibly, in apportioning charges in any particular instance, but here is a problem of trying to draw a conception of a thing for a period of years.

We know the average life of a plant, but even that varies over wide ranges, depending upon the different localities, upon sleet storms, prevailing in some localities and not in others; and the depreciation reserve, I think, would have to be modified. It seems to me that maximum depreciation reserve is a factor of the age of your plant. I was wondering if any interpretation of that kind had ever been placed upon it, and what Mr. McCollum considers ordinary wear and tear, and if he concedes that it does vary with the age of the plant.

Mr. P. B. Yates (St. Catharines)—Mr. Chairman, is not a lot of this which we are discussing largely due to the fact that, under our present system of accounting, we maintain our plant and are paying off the cost of the plant through the sinking fund, we really have no depreciation of the plant. Should that term "Depreciation" be changed, and instead of it, should we use the word "Antiquation" or "Obsolescence." As you all know, we maintain a plant out of revenue; the life of a pole will vary from six

to sixty years; some of them are very long lived, and we see some that have been up for a good many years—sixty years is an exageration, of course. But, with most of our debentures issued for thirty years, at the end of the thirty years our plant is still in full operating condition, and absolutely debt free; the debentures have all been paid, in accordance with the sinking fund arrangement, and we have a reserve on our hand to take care of a plant that is costing us nothing and that is in full operating condition.

I had, at one time, a number of great arguments with a very famous accountant, who has been accountant for some of the municipal Hydro systems; and when he asked me what we were charging for depreciation, I told him what the standard rate was, five per cent. on the tangible valuable of the plant, and he thought that was wholly inadequate. He stated, at that time, that under the English law a municipal plant cannot charge depreciation as an item of cost to the plant, as an item of cost to the service, and at the same time pay off their debentures, that that is charging their customer twice for the same thing; that, as the plant, we will say, in actual tangible value decreases,—I want to keep away from the word "depreciation,"—the debentures issued against the plant are also decreased, and therefore a depreciation charge was not necessary and was not allowable. But he insisted that we charge a depreciation account of eight per cent. to take care of reserves for storms and for losses through lightning, in the way of transformers, and for obsolescence, and everything else. He said that he did not believe we should charge any depreciation, but that the Hydro Statutes required that we should charge depreciation, and, if we were going to charge any we had to charge enough.

It is my opinion that we would get away from a lot of this trouble if we could drop the use of the term "depreciation" and use the term "reserve for contingency" and for "obsolescence," and for "antiquation."

Mr. McCollum—I will try to answer the questions in the reverse order from that in which they were asked.

The term which we use in the municipal books as "depreciation" is represented in the Hydro Commission accounts by the word "renewals" which means the same thing. The difference is that in the Commission accounts they have a small additional charge which they call "contingencies" which is not provided for in the municipal accounts at all. We have always gone ahead with the hope that the free surplus, that is the profit over and above all other charges, would be sufficient to take care of any contingencies which might arise. Up to the present, with the exception of the sleet storms in this last spring, there has been nothing worth speaking of in that line in connection with Hydro operation.

There are three different plans by which operating charges are grouped, so far as I know. There is the plan called the Seattle plan; they charge to their revenue operation, depreciation, interest and sinking fund, but they do not charge any maintenance. They charge a theoretical depreciation, and then the actual maintenance

expenditure is charged against the depreciation reserve. In that way they know, on the first day of January, exactly what their operating expenses are going to be for the year on which they are entering, because they know what the salary of the staff is, they know what the carrying fund is and the sinking fund and the depreciation rate; so that they know exactly what their expenses are going to be—it is a fixed line and does not go up and down, and the maintenance goes into the reserve.

In Winnipeg, where they have a very extensive municipal system, they do it a little differently; they charge operation, maintenance, depreciation and interest; they do not charge sinking fund. They take the position, which is quite a logical one, that you cannot justify a charge to a consumer of depreciation of a plant and also make him pay for the plant. So they maintain it, and let posterity pay for it if it wants to; they give it a plant as good as they had, maintained up to a certain standard.

The Hydro has gone one better than the others, because they have assumed the whole burden and say, "We will build the plant, maintain it, pay for it through the sinking fund, and also pay for the replacements."

During the first three or four years the debentures were issued almost universally as thirty years debentures, and there were a few forty years. Since 1916, so far as I know, ninety per cent. of the debentures have been on a twenty year basis, and, of course, it takes a higher sinking fund on a twenty year than on a thirty year basis.

The Hydro plan is ultra conservative, assuming all the burdens that the other systems impose, and also adding an additional one. And, if nobody suffers, why not be doubly sure?

Mr. Drewry raised a question as to what was the basis which would justify a maximum percentage of your tangible plant as a reserve. I think the grounds for that is that in order to operate sucessfully a telephone system or a distribution system you have to maintain it up to a certain standard. You cannot operate it up to the point where it will all go to pieces at one time. It does not consist entirely of twenty year units; there are a lot of items which will go to pieces in six years. Assuming that your plant has a composite life of twenty years, it has never happened in actual practice that a plant is gone in the twenty years. In the meantime, you have renewed your cross-arms twice, and your poles once, and your second poles will be only eight years old and still have a life of four years; besides that there is a residual value in your wire, which never depreciates more than sixty-five or seventy per cent., so that if you are going to operate your plant and give it the periodical inspection which it must have, the renewal of your cross-arms and of your poles and the doing of the work which an ordinary inspection involves, if you accumulate more than a thirty per cent. reserve, it is too much.

The other point which Mr. Drewry raised is as to what is wear and tear and when the time of maximum maintenance is reached. That was the object aimed at when working out the Uniform Accounting system that we

might obtain a uniform maintenance expense, anticipating obvious replacements and providing for them from the beginning of operation through the medium of the depreciation reserve so that when the replacement was actually made, the cost was not reflected in the expense account. In theory, providing the depreciation rates are correct, the annual charge against revenue, that is the sum of ordinary wear and tear, and depreciation, will make a perfectly flat horizontal curve, from the beginning of operation, regardless of the age of the plant. The unavoidable fluctuation in the annual cash outlay on renewals is absorbed in the balance of depreciation reserve in the balance sheet, but does not in any way affect the profit or loss account or have any influence on the yearly rate adjustments, which is the real objective.

In the Seattle plan, where they have a depreciation charge of seven or eight per cent., which is enough to take care of every unit in their plant, as fast as they replace a unit, they put it in as a maintenance charge; then maintenance goes into depreciation reserve, and not into profit and loss.

Mr. Martindale raised a point as to who should assume the cost of moving poles from one location to another in the street, due to some work being done on the street, which is the same question as was raised by Mr. Heeg. I do not know that that is an accounting matter. It is rather a matter of common sense and justice. If you are serving a people with a service at cost and have erected a pole line, and the city wants to pave the street and to move the poles across to the other side of the street, why shouldn't that expense form a part of the cost of the road?

I think a precedent was established for that, in the building of the Hamilton Highway, when a lot of poles were moved from one side to the other for the convenience of the road. Of course, if some company had a franchise which gave them a right to plant poles on the street which belongs to the people, and the people want that street, they might have a right to charge that back. The granting of a franchise to use a public street should not carry with it any obligation to save the company from any expense growing out of the rightful use of the streets or highways by the municipality at any future time, but where the poles are the property of a publicly owned utility and are placed with the consent and approval of the municipal authorities it would seem that if at any later date, the rightful use of the highway requires a change in the location of the poles then the expense should form part of the cost of the new work.

In regard to the allocation of construction charges for a distribution system, insofar as street lighting is concerned, I think that the question is due to not understanding thoroughly the requirements of the accounting system. We have a capital account called street lighting. It is the only material which is distributed according to its use instead of according to its character; it is exceptional in that way. We have no corresponding capital account called house lighting or power. There

Mr. A. T. Hicks, Vice-President

is always some misconception as to what is street lighting equipment. A transformer in a sub-station is two things, sub-station equipment and street lighting equipment. This creates an ambiguous situation, which we could not work out in practice. In the revised edition, we modified the text in regard to street lighting equipment and limited it entirely to lamps, brackets and fixtures for light on the street and ornamental street lighting systems. We do not charge street lighting with any part of the poles or cross-arms or any wire because we do not charge any part of that to house lighting or to power. In determining the cost of serving the different classes, we sub-divide the entire cost of the distribution system into light, power and street lighting. If you charge street lighting with a part of the poles, etc., it will mean that your street lighting would get a double charge, when the distribution system is being apportioned in the head office and for that reason we do not want to put into street lighting anything except what would not be classified under any other heading.

In regard to the handling of the charges, in taking down a fifteen and putting up a twenty-five kilowatt transformer, Mr. Perry did not tell us what he was going to do with the fifteen when he took it out. If it is going to be put up in another location and is still a transformer, the only thing involved there is the cost of making the change in position. The fifteen is still a transformer, the same as it was before. In the one case you had fifteen kilowatt capacity on the poles, and the next you have forty

Mr. O. H. Scott, Chairman Papers Committee

kilowatts ready to be used as needed.

The cost of taking down the transformer and putting up the other one is the only thing which can be subject to discussion, as far as I can see it. The rest of it is clear. Strictly speaking, I would say that is not a true operating charge against the consumer in the year in which the work was done, because the condition which brought about that necessity was not the work of that year, but the load was increasing gradually, until you found you needed to make the change. You have been providing for it in your annual reserve set aside. Your depreciation rate includes theoretical replacements, whether the replacement is due to the termination of their theoretical life, or because of obsolescence.

I think I have answered all the specific questions that were asked, but if I have overlooked any I will be glad to be reminded and will do what I can to make my position clear.

Reports

THE SECRETARY'S REPORT

The membership lists for this year show an increase in the number of Member Utilities, while there is a falling off of Commercial Members. During the year 1921, there were 126 Member Utilities; eleven of these failed to renew their membership for this year, while seventeen new Utilities were added, bringing the number of Utilities up to 132. The Utilities that have dropped out are:—Delaware, Elora, Goderich, Hagersville, Milton, Mount Forest, Port Stanley, Tara, Toronto Township, Scarboro Township, Stayner.

The new Member Utilities are:—Arthur, Aylmer, Ayr, Baden, Beachville, Durham, Glencoe, Listowel, Newcastle, Niagara-on-the-Lake, Oil Springs, Orono, Picton, Port Colborne, Ripley, Simcoe, Springfield.

The Commercial Members for 1921 consisted of 45 companies. Nine of these have dropped out, while two new companies have been added, giving us 38 Commercial Members for 1922. The following are the companies who have not continued membership:—Chas. A. Branston, Limited; The Coffield Washer Co., Limited; Electric Refrigerators, Limited; Gillespie Eden Corporation; W. A. Kribs Co., Limited; The National Equipment Co., Limited; R. E. T. Pringle, Limited; The Slade Mfg. Co., Limited; Swedish General Electric, Limited.

The new Commercial Members are:—D. Moore Co., Limited; The Sterling Electrical Co.

Membership cards have been issued as follows:—

Class A	183
Class B	173
Commercial	137
Associate	65
Total	558

S. R. A. Clement,
Secretary.

Regulations and Standards Committee

As far as the committee is concerned, of which I am chairman, in talking with Mr. Hall, the Chief Inspector, and Mr. Dobson, I understand that they are preparing a new Rule Book, and no doubt it will be in the hands of most of the engineers and managers at an early date. There are going to be quite a few of the rules changed, which I think will be welcomed by all the members. The Rule Book in its present form is really not a Rule Book at all, because there have been so many amendments and bulletins sent out that the Rule Book has become practically useless, and I think it is time that something in this line was done. Otherwise, we have not heard any complaints from municipalities.

Merchandising Committee

At a joint meeting of Inside and Outside Merchandising Committees held on January 25th, 1922, at the offices of the H.E.P.C., there were

formed four sub-committees as follows:—

Purchasing Committee,
Educational and Advertising Committee,
Servicing Committee,
Accounting and Collections Committee,

and each of these committees was instructed to look into the problem of furthering the interests of the Hydro municipalities in merchandising matters, and to submit suggestions for properly conducting the Merchandising Campaign. Following this meeting, the Purchasing Committee met on January 26th, and it was decided to obtain from all municipalities selling merchandise, a specification of their sales for the year 1921, as well as a schedule of the probable sales for 1922, upon which could be based an estimate of the probable total requirements of all Hydro municipalities for this year. In response to an appeal to the Hydro shops for this information, all but one or two sent in the information, which was compiled and used as a basis for further consideration of the problem of buying supplies for Hydro shops through the Purchasing Committee.

The Purchasing Committee held a meeting on April 20th, and were presented with the compiled list of Specifications for the Hydro shops for the year 1922, and discussed ways and means of approaching manufacturers of the various appliances manufactured and supplied, with a view to obtaining the very best prices on the amount of business set out in the schedule. After thoroughly discussing the problems confronting them, it was decided to leave the matter to the Purchasing Department, in whose hands the question of obtaining prices still stands. Before overtures could be made to the manufacturers, some definite plan governing the merchandising activities of the H.E.P.C. was necessary, and bearing this in mind a meeting was called of the Educational Committee, to discuss the proper methods of conducting an advertising and educational compaign in Ontario.

The chairman of the Educational Committee submitted a detailed report of suggestions as to the proper way of conducting an educational campaign, and with these suggestions several advertising agencies were approached and asked to submit propositions along with the probable cost of campaigns to cover the Hydro requirements. Two such propositions are at present under consideration, and should they meet with the approval of the Commission, the municipalities will be notified in due course of their complete operation, and the co-operation of all municipalities in carrying out the plans is earnestly asked for.

The Servicing Committee held a meeting on January 26th, and discussed the principles which should govern the servicing of appliances in the Hydro municipalities. The deliberations of this committee are not quite complete, and when the full programme has been definitely decided on, it will be presented in the form of a pamphlet for reference to every Hydro shop.

The Accounting and Collections Committee have not yet held a meet-

ing, but information has been collected on accounting methods employed in Hydro shops and in similar lines of business elsewhere, with a view to getting the best that could be had for the purpose, and accounting systems to take care of the merchandise departments were installed in a number of municipalities along these lines as a trial, after the operation of which, it is expected printed instructions will be issued to the Hydro shops, to carry on their accounting in this way.

Rate Committee

A meeting of the Rate Committee was held at the office of the Hydro-Electric Power Commission of Ontario, on February 28th, 1922, and the following members were present:—

Messrs. M. J. McHenry, V. S. McIntyre, J. E. B. Phelps, J. J. Heeg, O. M. Perry, P. B. Yates, J. E. Brown, G. J. Mickler, H. F. Shearer, R. T. Jeffery, S. J. Millikin, R. H. Staford, T. R. C. Flint, E. J. Stapleton, E. I. Sifton, J. J. Jeffery, G. F. Drewry, L. G. Ireland, S. R. A. Clement.

Rates for Domestic Service were discussed with the object of fixing a minimum rate for this class of service, and disapproving of the use of a second follow-up rate. The following resolution was therefore carried:—

"Resolved, that in the opinion of this Committee, the standard domestic rate of 3c., 2c., and 1c. is sufficiently low for domestic service, and that any abnormal surplus should be absorbed in improvements in service, such as feeder regulators, underground feeders, and devices to regulate, improve and especially insure continuous service; and that the Engineering Department of the Commission assure themselves that every safety device and improvement be covered before any reduction in such rates be considered."

In dealing with the subject of rates for electric water heaters, referring to the suggestion that there be a flat date based on the cost of power to the municipality, plus $10.00 per year, it was apparent that a further study should be made before making any recommendation. The following resolution was therefore carried:—

"That the Commission be requested to re-estimate rates for electric water heaters and refer the same to this Committee for consideration, the rates to embody the following:—

1. They are to encourage the use of low capacity heaters.

2. Flat rates are a correct form of rates for this class of service.

3. The flat rates must be low enough to encourage the use of heaters, yet high enough to meet the cost of service.

4. It is assured that there is no diversity from the water heater load and that at least 75% of the heaters are on all of the year."

In dealing with the suggestion of fixing a service charge for permanently installed heating appliances, the Committee adopted a resolution—

"That there be an additional service charge of twenty cents (20c.) per month per kilowatt of connected load for all permanently installed electrically operated appliances having a capacity exceeding 660 watts, with the exception of electric cooking appli-

ances. For electric cooking appliances this additional service charge shall apply to 40 per cent. of its capacity with a minimum of 2,000 watts. The distribution of kilowatt-hours used will remain as heretofore, *i.e.*, based on the floor area of the house."

There was also a resolution adopted:—

"That the Hydro-Electric Power Commission of Ontario be requested to authorize the refusal of the Municipal Systems to serve instantaneous water heaters."

MINUTES OF CONVENTION

The convention was called to order by the President, Mr. M. J. McHenry, at 2.30 p.m. on Thursday, June 22nd.

It was moved by Mr. H. O. Fisk and seconded by Mr. A. T. Hicks: That the reading of the Minutes of the last convention and of the meeting of the executive committee be dispensed with and that the Minutes be taken as read and adopted. *Carried.*

The President then addressed the Association welcoming the delegates to the convention and outlining the work carried on since the last convention.

The Secretary then presented his report showing an increase in the number of member utilities from 126 to 132. Commercial members have decreased from 45 to 38.

It was moved by Mr. H. F. Shearer and seconded by Mr. O. M. Perry::— That the Secretary's report be adopted and that D. Moore Company, Limited, be accepted as commercial member and A. N. Hunter and R. P. Darrell as associates. *Carried.*

Mr. J. J. Heeg, Chairman, Regulations and Standards Committee, presented a report, which showed everything to be progressing favorably.

Mr. G. J. Mickler reported on behalf of the Merchandizing Committee. On being moved by Mr. O. H. Scott and seconded by Mr. H. O. Fisk, the report was adopted.

Mr. O. M. Perry presented a report for the Rate Committee and moved that it be adopted. Mr. Perry's motion was seconded by Mr. R. H. Myers. The report contained a recommendation that there be a service charge for electric ranges.

Mr. W. H. Childs moved and Mr. J. J. Heeg seconded an amendment that the report be adopted with the exception of the suggested service charge for ranges; it to be left in abeyance until a further meeting of the Association. *Carried.*

Mr. A. T. Hicks, Chairman, Committee on Accident Prevention and Health Promotion, presented a report from that committee, details of which have been published in THE BULLETIN previously, and moved its adoption. On being seconded by Mr. H. O. Fisk, the resolution was carried.

The President then introduced Dr. C. J. Hastings, Medical Officer of Health for the city of Toronto, who gave an address on "Public Health as a National and Industrial Asset."

Following Dr .Hastings' talk, Mr. Wills Maclachlan gave a short talk on Safety-First Work. Dr. Hastings then answered a number of questions by the delegates, after which he was extended a very hearty vote of thanks for his very interesting talk.

The session of the convention was then adjourned.

At 6.30 p.m. the Association met for its convention dinner. Honorable I. B. Lucas, counsel for Hydro-Electric Power Commission of Ontario, was the guest of the evening who gave an address on "Co-operation," and was very heartily received.

The second session was called to order at 9.50 a.m. on Friday, June 23rd, when the following papers were read:—Modern Street Lighting from Construction and Apparatus Standpoint" by M. B. Hastings, Secretary A. H. Winter-Joyner, Limited, and "Modern Street Lighting from Illumination Standpoint" by R. M. Love, Street Lighting Specialist, Canadian General Electric Company, Limited. Both papers were illustrated with lantern slides. Discussion following these papers was by R. H. Martindale, H. F. Shearer, J. J. Heeg, Geo. L. Alexander and C. E. Schwenger.

Mr. Hastings and Mr. Love were then extended a very hearty vote of thanks for the information given by them.

Mr. E. I. Sifton presented a draft of a resolution in reference to the Murray-Flood report.

Moved by Mr. H. F. Shearer and seconded by Mr. T. M. Staunton:—That Mr. Sifton's resolution be referred to a committee to re-draft it and report back to the Association at the afternoon session. *Carried.*

The President named Messrs. E. I. Sifton, O. H. Scott, R. T. Jeffrey, H. F. Shearer and R. H. Martindale, a committee to re-draft Mr. Sifton's resolution.

The session of the convention was then adjourned.

The convention resumed at 2.30 p.m. when Mr. R. C. McCollum, auditor, municipal accounts, Hydro-Electric Power Commission of Ontario, read a paper entitled, "Some Peculiar Phases of Allocation of Charges for Municipal Electrical Utilities." Discussion following this paper was by Messrs. L. G. Ireland, G. J. Mickler, J. J. Heeg, O. M. Perry, R. H. Martindale, G. F. Drewry and P. B. Yates. On being moved and seconded a very hearty vote of thanks was extended to Mr. McCollum for his very valuable paper.

The committee appointed at the morning session to re-draft Mr. Sifton's resolution reported back, and the following resolution, moved by Mr. E. I. Sifton and seconded by Mr. J. E. B. Phelps was carried.

"That this convention of engineers and managers of the Association of Municipal Electrical Utilities place ourselves on record as condemning in the most emphatic manner possible the report of Engineers Messrs. Murray and Flood made to the order of the National Electric Light Association, in which report claims are made and represented which to our knowledge are absolutely false and mislead-

ing as regards the basis of operation and control of the Hydro-Electric Power Commission of Ontario, and the cost of power and light as supplied by Hydro municipalities, compared with the cost of current as supplied by private companies in Quebec, Buffalo, New York State and other states of the Union. We believe the same was made with intent to mislead public opinion in Quebec and New York State in particular and other sections of the continent in general. Also we believe the report is detrimental to the industrial expansion of this banner province, Ontario."

Mr. K. A. McIntyre, representing the Society for Electrical Development then addressed the Association, outlining the work that organization was doing.

Mr. F. Gover extended to the Association an invitation to hold its convention next summer at Orillia at the National Y. M. C. A. Organization Park. This matter was referred to the executive committee.

The convention then adjourned.

At 4.30 p.m. the delegates met in the Queen Victoria Niagara Falls Park, where a baseball match was played between the utility members and the commercial members.

An informal dance was held that same evening beginning at 9 o'clock.

On Saturday morning, June 24th, the delegates visited the Queenston power station.

The register shows the attendance at the convention to have been as follows:

Class A	89
Class B	23
Commercial	82
Associates	36
Guests	21
Total	251

THE

BULLETIN

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CONTENTS

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AUGUST, 1922

Rules for Accident Prevention to Employees

The Hydro-Electric Power Commission has had a booklet prepared giving Rules for Accident Prevention to Employees, which it recommends being used throughout all its Systems. The booklet is pocket size and is intended to be carried on the person of each employee so that he will always have it with him should it be required. It should be placed in the hands of every employee of the Municipality who has anything to do with the construction or operation of sub-stations or distributing systems, and he should immediately acquaint himself with its contents and then keep it with him for future reference. The booklet is prepared in loose leaf form to permit the insertion of additional pages as they may be published from time to time. It is recommended that all utilities adopt it and have their employees put it to the use for which it is intended.

The Hydro-Electric Power Commission will be pleased to send a sample copy to any Municipal Electric Utility making application for the same, and is desirous that all should avail themselves of this opportunity.

Nipigon Development

The Commission has recently prepared and distributed a pamphlet entitled "The Nipigon Hydro-Electric Delevopment Constructed and Operated for the Municipalities of the Thunder Bay District." In this pamphlet is given the history of the

early agitation for electric power in the Thunder Bay District as well as all matters pertaining to negotiations between the municipalities at the head of the Lakes and the Hydro Commission concerning the initial delivery of Hydro Service to Port Arthur and Fort William. Complete details are given concerning the relations with the Kaministiquia Power Company; facts concering the possibilities of power development on the Kaministiquia River as compared with the various sites on the Nipigon River.

All conditions leading up to the installation of the Nipigon Development are given in detail, as well as information concerning rates and the possible market for power in the district.

A description is given of the advantage of the Twin Cities as an industrial centre and statistics are submitted in the pamphlet concerning the commercial possibilities of the district.

A complete description of the Nipigon Development, with illustrations, appears in the pamphlet in the form of an appendix.

To any reader of the Bulletin desiring all of the facts concerning the Nipigon Development and Hydro-Electric Service at the head of the lakes, together with information concerning the commercial possibilities of the Twin Cities, no better source of information can be obtained than this pamphlet, and copies of same may be obtained upon application to the Commission.

The Aim of The Bulletin

There has been appearing on the fourth page of the cover of the Bulletin a notice outlining its aim. It is "to provide municipalities with a source of information regarding the activities of the Commission" and also "to provide a medium through which matters of common interest may be discussed and to promote a spirit of co-operation between Hydro municipalities."

We would like to see our readers taking more advantage of the opportunity offered. There are problems arising out of the operation of the Municipal Systems, the solution of which would prove of benefit to others. Then again there are ideas that have been tried out by some. Others will find those ideas useful and from the results obtained would be governed as to future action. It does not seem that all of the utilities are running along smoothly and that nothing of any particular interest is happening.

And again there is another way in which our readers can assist. In preparing papers for publication, subjects are chosen which are believed to be instructive to the municipalities. We believe that our readers may have ideas on the subjects discussed. Contributions treating of such subjects are always valuable and help to increase the usefulness of the publication.

The Commission publishes the Bulletin for the benefit of the municipalities. The municipalities therefore having a personal interest in it should take every opportunity of using it. It is in their power to increase the value of the publication and it is trusted that readers will keep this in mind and will not hesitate to contribute anything that has proved of value in their work.

New Home of Galt Public Utilities Commission

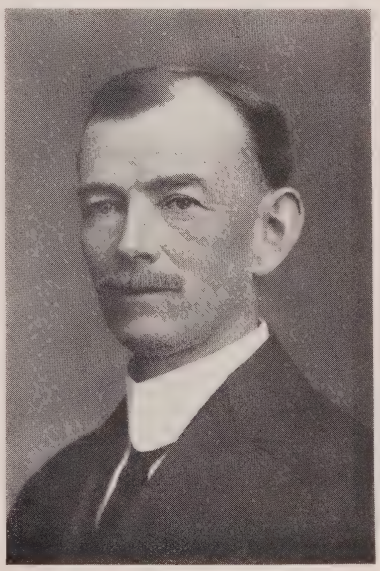
JULY 28th was another red letter day for Hydro, being the day on which the handsome new office and sub-station building was declared opened by Sir Adam Beck. The opening ceremony took place in the show room, in the office section, in the presence of the Public Utilities Commission Officials and a large gathering of citizens of Galt and men interested in Hydro affairs from all over the Province.

The new Public Utilities building is said to be not only the finest in the city of Galt, but also one of the finest in the Hydro system, combining all the most modern ideas in buildings for this purpose. The simplicity of the exterior is what is known as the straight style, stone ornaments and the large show windows of the Office Building providing relief. The building is three stories in height throughout, of Ohio sandstone and brick construction, with the foundation of concrete and Queenston stone. It is the first all steel office structure to be erected in the district, with reinforced concrete floors and all of the interior construction carried on the steel frame work.

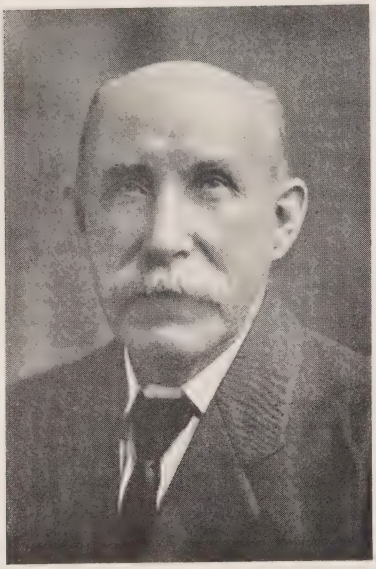
The office section of the building is entirely separate from the sub-station, the two being divided by a solid fire wall, with a stairway and elevator between the two departments enclosed in fire walls. The two sections are connected by fire-proof doors and each section has its own entrance.

The basement of the building provides work shops for the waterworks and electrical departments, space for the rotary converter and storage batteries for the operation of the sub-station switch gear and for the heating plant for the building.

The double entrance to the office section from Wellington and Dickson Streets, opens into a good sized vestibule which is of walnut finish. This leads into the show room and main office. This room is finished with a dado of grey marble, light grey stucco walls and an ivory tinted keen cement



W. H. FAIRCHILD,
Manager, Public Utilities Commission of Galt,



ROBERT ELLIOTT
Assistant Manager, Public Utilities Commission of Galt.

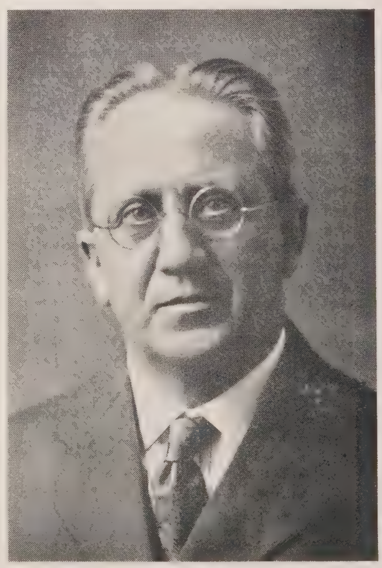
The general layout and the switching equipment has been designed for 26,400 volts although the present operation is at 13,200 volts. The incoming line entrances are located on the roof of the building, the leads being brought into the 13,200 volt switching and lightning arresters located on the third floor. The transformer room is at one end taking up of the space of the first and second floors while the 2300 volt switching and entrances are located on the second floor at the other end. The control room is located on the ground floor beneath the 2300 volt switching. All 13,200 and 2300 volt switching is direct current electrically operated from the control board, each control switch being provided with pilot lights.

The complete building as it stands cost $160,000 while the electrical

beamed ceiling. The floor is of Terrazzo with a ceramic tile border. The interior wood trim is in walnut finish with show-room fixtures and main office grill to match. The lighting is from Duplexalite fixtures, 70 per cent indirect. The Secretary-Treasurer's office and the billing room are off the main office.

On the second floor are the offices of the Manager, the Assistant Manager, and the Board room. The finish on this floor follows the same general scheme used on the ground floor. The third floor is left unfinished, and is used for storage of electrical appliances and wiring equipment.

The main entrance to sub-station section is from Wellington Street, leading to a stairway connecting with the three floors.



A. B. SCOTT
Secretary-Treasurer, Public Utilities Commission of Galt.

equipment entailed an expenditure of $60,000 making the total cost $220,-000. The work of removing the buildings that previously occupied the site commenced in April 1921, and the building was occupied on July 3rd last. Manager W. H. Fairchild was in sole charge of construction and all materials, insofar as possible, were "Made in Canada." The electrical arrangements were worked out under the superintendance of Assistant Manager, Robert Elliott, to whom the lion's share of the credit is due.

Ample provision has been made for the installation of additional equipment as the future growth of the load in Galt may warrant.

The executive staff who were responsible for the work consisted of Messrs. W. H. Fairchild, Manager, Robert Elliott, Assistant Manager and A. B. Scott, Secretary-Treasurer.

Galt Public Utilities Commission is composed of Messrs. G. Turnbull, Chairman; R. B. McGregor, G. Hancock, Jr., A. W. Mercer and Dr. S. E. Charlton, Mayor.

Show Room, Public Utilities Commission of Galt.

What I Found Out on a Residence Survey

Some Personal Experience in Investigating Residence Service Conditions with a Few Suggestions that Come Out of It—Getting the "Feel" of the Public

By CLARA H. ZILLESSEN,
Advertising Department, Philadelphia Electric Company

Residence surveys in many cities are serving to focus attention on a matter which has already been side-stepped for too long a time. We have known that a goodly number of folk have laid away their chafing dishes, percolators, grills and even their flat-irons on the closet shelf and have given up the use of them. And we have said that this is natural, because so many people purchase things like this on impulse and then, because old habits and traditions die hard, carelessly neglect to organize unaccustomed elements of service into their daily living.

But the surveys have discovered also that too many housewives are not using their vacuum cleaners and their clothes washers and their fans and mixing motors in the way they should. They are not depending on them enough. They are not using them as often and as much as we have taken for granted that they would.

There is nothing to be alarmed at. Most people who possess these electrical appliances do use them because of their great labor-saving and comfort value. But the fact that any of these appliances are abandoned or half-used is something that concerns us all.

The reason seems to be a lack of thoroughness in selling. Salesmen are taking advantage of the ready appeal of these household devices to sell them easily, without establishing adequate enduring confidence in the need for their constant use. For clearly no woman would apply a vacuum cleaner once a month and broom-sweep in between who really understood the superior cleanliness of the electric sweeper It is not enough for the dealer or the central-station or the manufacturer to sell such an appliance. He must so sell it that it will be used habitually with complete reliance. And apparently it would be well for electrical appliance salesmen to give more thought to this.

It is an interesting thing sometimes to put your finger out and for a minute personally get the "feel" of the public that we talk so much about. The residence survey offers such an opportunity, although it does not always provide it in full measure. The survey man is apt to be intent on getting the job done and eager to fill his card and be gone quickly. But it takes a bit of time, with patience, comprehensive purpose and an understanding mind, to really make the friendly contact that is necessary if

the full part that electricity is playing in the habits of each home is to be found out. Miss Zillessen has an unusual background and an eager interest, and her experience on the Philadelphia survey gives reflections of conditions as they are that are worth pondering.

Electrical World, July 15, 1922.

DOFFING the shell-rimmed spectacles which are the outward manifestations of the fact that I am an advertising writer, and donning the identification badge and portfolio of the regular members of our survey squad, I recently sallied forth on a doorbell-pulling adventure in search of sales and advertising data on that mysterious and elusive element which we know as "the public." Our company is making a partial survey in certain districts in Philadelphia of commercial and residential properties —mostly the latter. It has primarily the purpose of definitely locating potential business, but also of obtaining accurate and first-hand information regarding our customers' knowledge of certain company policies and their feeling toward the company in general.

So with my fingers crossed and a new pair of rubber heels on my most comfortable shoes I started out. The first move was to disarm possible suspicion with as heartfelt a smile as could be mustered; then to identitfy myself and declare my errand—to wit, to ascertain if service, lights and so on were satisfactory; next to gather data regarding sizes of lamps used, appliances and number of hours' per week and similar miscellaneous information, all of which was duly recorded. I took my time and tried to ingratiate myself into the confidence of the housewife or house owner, so that they would talk to me fully and freely and without the self-consciousness people are apt to feel when being assailed with rapid-fire questions by the professional investigator.

The districts I "worked" might conveniently be classified into three types of properties. The first comprises houses which were built about twenty-five years ago and most of which have been wired within the last five years —the majority of them within the last year or two. Those living in them are probably people with incomes of $3,000 to $5,000 a year—conservative, quiet-living individuals, with parlors instead of living rooms, closely drawn shades and a sort of mausoleum air about the lower floor. You know the type!

Another class was of the small houses occupied apparently by people of very moderate means—clerks, machinists, printers and small storekeepers. These people live on a very close margin, but nearly all of them have one or more appliances. They have bought their homes already wired and obviously take their electric service as much for granted as they do their bathrooms.

The third type I interviewed were apparently a little higher up in the social scale, for these houses boasted of an occasional maid. These homes, too, were wired when built, and nearly all the occupants have cleaners and flatirons, at least. The mere fact that the occupants have more money, however, does not put them in the higher ranks of intelligence, as my story will show later on.

This survey work is rich in human contacts. You meet all kinds—busy mothers, society ladies, dear old grandmothers, indifferent maids, curious old grand-dads, noisy children, talkative folk, abrupt and sharp-spoken ones, kind people and some not so kind—all the types that go to make up this world of ours. Meeting customers face to face in their own homes certainly does provide a lot of curious high lights on the broad scope of electric service and how it has woven itself into the fabric of home life. But sometimes I used to get almost heartsick to see how many women there are who, with the means right at hand to live comfortably and happily, take years out of their lives and waste precious energy, because they run their homes with no better tools than those to which their grandmothers were restricted.

Flatiron Reactions

My first few days on the survey were a constant surprise to me. I used to ring the doorbell of a house and think: "Well, I wonder what new thing is going to hit me now." I got a few serious shocks those first weeks. I was thoroughly "sold" on the idea of electric service in the home. We have all sorts of electric labor savers in my own home which are used to the limit. The idea of persons having these things and not using them therefore didn't fit into the picture at all.

I have never understood where all the electric flatirons that are sold go to. Thousands are sold every year and everybody seems to have one. Lots of people have two or three and they usually treasure them as if they were worth their weight in gold. But every once in a while (and more often than you'd think) I came across some woman who hasn't bridged the gap between this generation and the last, who has an electric iron and deliberately either uses the old-fashioned iron herself or lets her maid do so. I tried hard to get at the mental attitude that would intentionally do an already hard job the hardest possible way, but it couldn't be done. People like that have shifters' minds—you drive home an argument one way and they dodge away. They shift to some other point, equally weak, from which they will slide as soon as your ammunition is trained there. I came to the conclusion that such women were practically walking in their sleep and that nothing short of explosive advertising would wake them.

I sold electric sweepers once from house to house when they first came on the market—when they were ugly big brutes to haul over a carpet, anything but the light compact machines we have to-day. That early training instilled into my very marrow the absolute need for an electric cleaner in every home. I had cleaned too many so-called clean carpets for the first

time with an electric cleaner, with the usual result of over a quart of dirt, to believe that a broom or carpet sweeper, no matter how vigorously wielded, can keep floor coverings really clean.

You can imagine my "reaction" when day after day questioning revealed that the majority of women are really not using their electric cleaners often enough. Certainly once a month will not keep carpets and rugs free from dirt, even though supplemented by unnecessary hard broom cleaning. I used to tell these women that all the household experts say that the easiest way of taking care of a house is to "keep a clean house clean," that an electric cleaner should be used at least once a week, that hundreds of good housekeepers go over their rugs every second or third day, that estimates from all over the country indicate that the average family can make liberal use of an electric cleaner for a whole year for about $2.50 worth of electricity.

I remember one attractive frail little lady who lived in a good-sized house. We were talking about this question of cleaners, and I asked her how she used hers. "Well," she said, "once a month I go over the house thoroughly with the broom and then with my electric cleaner." Can you imagine it? There is nothing much harder for a woman than to sweep a whole house with a broom. But she had been habitually doing this, with a good cleaner, and expensive machine ready there in the home to do the work for her. There is only one explanation, and that is that the salesman had not sold her full confidence in the machine when she bought it.

The Antipathetic-Servant Pose

The thing that used to make me nearly explode with impatience was when somebody would tell me she didn't need an electric iron or an electric washer because she "had somebody to do the washing." Or she didn't need an electric cleaner because she had a good maid who didn't mind using the broom and carpet sweeper, was really "sot" against any electrically driven appliance. I have come to the conclusion, however, that a lot of this so-called objection among servants against electric labor savers is purely mythical and merely a wall behind which the employer intrenches herself because she would rather spend the money for something else.

It's usually the older generation that has this weird idea of not saving servant labor. I remember interviewing a mother and two daughters on the subject. It was one of those hot days of early spring and we were seated in the cool, pleasant living room. The mother said that they had an electric iron for light pressing upstairs, but that her maid used the old-fashioned ones and that she was at that very moment ironing the family wash. The daughters were obviously ashamed of this condition, realizing, as they did, the incongruity of their sitting idly in a cool, attractive room with the maid bending over the hot stove using an old-fashioned iron. The old lady militantly countered that she wasn't one to spoil her help by "put-

tin' a lot of new ideas in their heads." She had employed help for thirty years and she knew!

Washing and Wiring

And then the arguments about the electric clothes washer! All sorts of wild ideas—from fear of shock all the way down the line to the fact that they had heard a washer was hard on the clothes, and that it was cheaper to send them to the laundry. Over and over I told the same old story—the washer was easier on clothes than the hand method of rubbing; it was perfectly safe to use; it was demonstrably cheaper to use a washer than to send the things to the laundry.

You never could tell from the looks of a house, either, whether it might not have a complete electric laundry. A lot of cheaper houses had washers, because these people of limited means are used to buying on credit and many of them had bought their washers by the same method by which they had acquired their player-pianos and victrolas. These are the practical people, who are struggling to rear families and save money on limited incomes, and the housewives of this type will deny themselves to get a really efficient labor saver.

Looking over my records, I find relatively few houses called upon that were not wired for electric service. The very large majority of people owning their homes undoubtedly want electric service. There seems to be only one bugbear—the real or fancied expense and the general lack of knowledge as to just how much it will cost to wire the particular property in which they are interested. Judging from my survey of unwired houses, I should say that there are a lot of these "prospects" just sitting on the fence, waiting to be pushed off by means of a campaign on housewiring which will tell them definitely how much it will cost and how they can pay for it.

One condition I encountered that was rather surprising. The survey people are trying to educate our consumers to use the proper size lamps, and they carry literature along this line which will be helpful. In raising this point as I went on with the work, I was astounded to find that nearly every woman knew just exactly what size lamps were being used in different parts of the house, naming them by wattage. Not once did I hear the word "candlepower." Together with a great many other persons, I had always believed that the women of the house were a bit vague about lamps and their sizes, and it was refreshing to find the very great majority of them using and knowing all about the proper tungsten lamps to use.

When a few days had passed after finishing this self-imposed task of surveying, my more or less chaotic impressions had simered down to something like this:

Things to Remember in Advertising and Selling Housewiring

1. Find out definitely what kind of potential business there is along each line—where and what type of house and people you will have to deal with.

2. Get the cream of the business first. Talk a definite plan, prices and terms. This is important for many

house owners are "sold" on the idea of electric service, but have a vague and generally mistaken idea of price.

3. Get a set of wiring plans—nearly any of the model "electric home" plans will do—and give them broad distribution. Remember that nearly everybody—whether he or she has a home or not—is susceptible to the insidious attraction of playing with house plans.

4. Keep after neighbors and friends of people who have recently wired—they are splendid prospective customers.

Things to Remember When Advertising and Merchandising Appliances

1. Keep everlastingly at it. Repeat the fundamental facts of what the appliances will do and what they will save—their prices and selling terms—and keep on repeating and repeating until you think the public must be sick of the story. And then keep on repeating, for just about then slight glimmers of understanding will be evident.

2. Make your sales and advertising talk in plain, simple and everyday English. Use no "hifalutin" language or "subtle stuff" which shows your nimble and agile mind, but bread-and-butter facts which every one can understand.

3. Be sure the appliance is properly sold. High-pressure salesmanship often sells appliances without the purchaser's being really confident. This is often the purchaser's fault, but the manufacturer's and distributor's salesmen should reckon with this fact and see that every purchaser thoroughly understands all the uses and the necessity for frequent use (when this is so). Both central stations and contractor-dealers will find this advice pertinent.

4. Make a mental classification of your merchandise. With the type on which the public is already thoroughly educated it is a matter of selling your make. The other class of appliance calls for educational work. To sell the first, talk terms, price, the points of your particular make. To sell the second, talk free trial, labor and time saving qualities, then terms, and lastly price.

Three Qualities That Win Sales

ENTHUSIASM - born of a knowledge of the goods and love of one's job.

AGGRESSIVENESS - built on the desire to meet a definite quota of sales,

COURTESY - remembering that the salesman's first aim is to serve.

Electrical Retailing, August, 1922

Merchandising Through Hydro Shops

By D. J. PHELAN,
Windsor Hydro-Electric System

ALMOST since the beginning of Hydro there has been considerable discussion as to whether the local Hydro Systems should maintain a department for the promotion and sale of electrical appliances.

Results already obtained in municipalities operating a merchandise department tend to prove that not only has this department performed an important function in increasing the residential per capita revenue, and the building of good will for Hydro, but it has also materially assisted the electrical industry in general, in the community where it exists.

In order to insure success, the Hydro shop must be operated on sound business principles. Public good will should include the good will of private dealers and contractors, which can be readily secured if the proper spirit of friendly co-operation exists.

Careful consideration should be given to the purchasing of appliances, keeping in mind that profits are more liable to accrue on merchandise which has a frequent turnover. The proper amount of stock to carry should be determined entirely by the turnover, too frequently the inducement of a slight additional discount leads to over-stocking, with a consequent loss due to depreciation and carrying charges which generally exceed the extra discount by a considerable margin.

Merchandise should be attractively displayed, both in the store windows and in the store. The idea that each customer has a proprietary interest in the store should be implanted in the minds of the sales staff, and they should be encouraged to keep the stock in such a condition, that customers will be proud of their Hydro shop.

The members of the sales staff should be carefully instructed in order that they may intelligently advise the public as to the appliances best suited for their particular requirements. The instruction may be carried on at general meetings of the sales staff, weekly or semi-monthly. Whenever possible manufacturers' representatives should be asked to attend these meetings and instruct the salesmen as to the particular features and advantages of the appliances which they sell. The sales staff should be encouraged to ask questions and bring up points which are not clear to them, at these meetings.

Particular emphasis should be laid on the fact that under no circumstances should a customer be told anything but the truth regarding appliances. Over-anxiety on the salesman's part to close a sale, sometimes leads him to exaggerate the usefulness of an article and may possibly result in a dissatisfied customer.

Every appliance should be carefully and thoroughly demonstrated to customers at the time of purchase, and it is also a good practice to call on customers after they have had an opportunity to use the appliance. This is sure to be appreciated by the customer and is a good method of obtaining prospects.

"SERVICE" as used in connection with electrical appliances, should mean exactly what the word implies. The value of any electrical appliance lies in the service it gives. If it does not give service the customer places the blame directly on the Hydro shop. It follows, therefore, that a first class service department in connection with the merchandising department is an important factor in its success. An accurate record of all appliances sold including date of sale, type of appliance, etc., together with the record of service calls on same, will prove exceptionally useful not only in checking the cost of service but also as a basis for bringing to the attention of the manufacturers possible improvements to increase the utility of the appliance.

When a customer makes a complaint, whether justified or not, he should receive courteous consideration and every effort should be made to adjust matters to his complete satisfaction, as the success of the Hydro shop is dependent entirely upon the good will and confidence of the public.

Municipalities now operating Hydro shops appreciate to what an extent they are indebted to the merchandising department for the good will existing toward Hydro and other municipalities would do well to consider this important matter carefully and take advantage of the opportunities which await them.

Why Utilities Should Sell Appliances

Severe criticism is arising in some Hydro municipalities against the Hydro Department engaging in the merchandise business, to sell electrical appliances to its customers in competition with local dealers and hardware men.

This criticism may or may not be justified, depending on local conditions, and the business policy of the shop criticized, but on general principles, it must be agreed that the Hydro shop properly managed is the logical medium through which electrical appliances can be obtained, and it certainly is looked upon always as the only place to get service on failing appliances.

"Why should local Hydro systems sell appliances?" is a question continually on the lips of the opponents of the Hydro shop idea. Here are several reasons why:

1. The Hydro system is vitally interested in the placing of appliances of medium or large capacity on existing lines. To give good service, the service wires must be adequate, the secondary street circuits must be adequate, and the transformers supplying

Toronto Power Company, Generating Station, from the North

these circuits of sufficient capacity to handle the load of the circuit. If loads are hooked up without the knowledge of the system's officers, the equipment could easily suffer damage or the customer receive poor service from an otherwise reliable appliance because of poor voltage. Were the sale of stoves and heaters controlled by the system proper distributing lines and transformers could be provided as required.

2. People whose homes are connected to the lines want appliances. They must have them or they will be denied a large part of the benefits of modern electric service. It is therefore clearly within the spirit and purpose of the service which this utility is organized to render, that it should assist consumers to secure these accessories and enjoy them.

3. Appliances by consuming electricity, increase the utility revenue from the consumers, so the system should work to sell more appliances to increase the load.

Right here it may be well to add that load conditions in one municipality make some certain appliance loads desirable, others objectionable and without the control of the sale of appliances, the objectionable ones are sure to find their way into consumers' homes through local dealers or outside sources, chiefly because of the profit to be made in their sale.

4. The Hydro shops, being interested in the development of load on the local system, might be compared to the manufacturer, bent on increasing the sale of his product. Each must develop the field requiring the product to be marketed and experience has

shown that every manufacturer must have a sales department to build up his business, not leaving that function to outside agencies, which have no interest in his welfare whatever, and over whom he has absolutely no control. No manufacturer would dispense with his sales department, yet that is exactly what the Hydro department does when it leaves all sale of appliances to contractors who in the final analysis have little in common with the distributor of electrical energy.

5. All central stations should merchandise appliances extensively and fully, and the methods employed should be of such a high grade that any electrical merchandising firm could compete on equal footing. No retail merchant fears clean-cut competition of the right kind, and there is no reason why the electrical dealer desires to have the field entirely to himself. If the Hydro sells on a basis on which the other retail merchants can compete, the department will control the sale in a way that sales should be controlled for the protection of its interests.

6. By building up the market and creating a demand for electrical appliances, the Hydro department attracts more dealers into the field and builds up the industry. The contractor begins to sell appliances because he sees that there is profit to be made in it, provided the Hydro department runs its merchandise business in a business way and maintains prices that will protect and encourage the dealer.

Investigation proves that the maximum results for dealers and contractors as well as for central stations, in merchandise sales and consequently appliance consumption, are achieved in those cities where the central station leads the way in progressive merchandising of appliances. That, in those cities the electrical development has been speeded up and the retail outlets for electrical merchandise have enjoyed a larger business than would have been the case had the utility been dormant.

Let criticism be constructive not destructive. If Hydro shops are not carrying on business properly, co-operation from the electrical dealer will eliminate the difficulties of doing competitive business and the business in electrical appliances will increase beyond tthe dreams of most contractor dealers.

History of the Hydro Lamp and the Reason

IN the operation of electric incandescent lamps there are two inseparably related factors by which the economy of operation is influenced. These are the efficiency and the life. Neither of these factors taken separately gives an indication of the real quality of the lamp. If a lamp of high efficiency is desired it is necessary to sacrifice some of the life to obtain this end and conversely long life can only be obtained at the expense of efficiency. A small increase in efficiency produces a very large decrease in life. In order to obtain economical operation consistent with good lighting it is necessary to study the factors that effect the cost of light and to select the best compromise between efficiency and life to suit the costs of lamps and power.

The relative importance of efficiency and life depends upon the comparative costs of power and lamps. It then becomes more economical to renew the lamps more frequently, as they are burned out, because high efficiency decreases the life. The higher efficiency lamps produce more light for the power consumed. On the other hand where the rates for power are low, as in Ontario, low efficiency lamps (longer life) will not require so frequent renewals and greater economy may be secured by lowering the renewal cost.

To make comparisons of the costs of lamp operation under different efficiencies with their corresponding lives and for different power costs it is necessary to reduce the results to a common basis such as the cost per candle-hour or the lumen-hour. In computing these values it is necessary to take into consideration certain essential factors such as, the lamp cost, the power cost, the average efficiency during life, the average candle power or lumens during life, the life, and for certain purposes it may be desirable to include a fixed charge on sockets and fixtures.

In America the lamp efficiencies are controlled by large companies whose headquarters are in the United States and the custom is to raise the efficiencies as high as possible without reducing the life below 1000 hours. Until the last two or three years the life was defined as the total time the lamps burned until the candlepower or lumens decreased to 80% of their initial values if failure did not occur before that time. It was observed that lamps as made at present usually do not last long after the 80% life has been reached and the 80% life has been abandoned in favor of the life to burn-out. The burn-out life is the life stated in all lamp data at present. Occasionally lamps are encountered that burn to a very low percentage of their initial candle power or lumen values and these are considered as having burned out when their candle power or lumens decrease to 60% of the initial value.

Ontario is a comparatively small part of total area served by the lamp companies of America and it is quite

Integrating Sphere Photometer, Hydro Laboratories

natural that the rates for power in the larger area have been included in calculations of cost of light upon which lamp efficiencies are based. It is well known, however, that the rates on the Hydro systems in Ontario are very much lower than elsewhere, which means that lights are left burning when not necessarily used. The lamp prices are practically the same throughout America.

This condition quite obviously favors the adoption of longer life lamps in Hydro-Electric territory. Calculations based upon the rates for lighting on Hydro systems and lamp costs in Ontario showed that the most economical lives were considerably higher than 1000 hours. From this fact and a general consideration of lamp operation as applied to Hydro systems it was decided that a lamp designed for 1500 hours' burning would best fulfil the requirements.

It then became necessary to provide specifications for the manufacture and testing of Hydro lamps.

The tests to which lamps are subjected are of three kinds:

1st, an inspection with mechanical and electrical tests that reveal defects of manufacture. These tests indicate the care that is bestowed upon their manufacture.

2nd, the rating test which reveals the accuracy of the technical data from which the lamps are made. This test involves the measurement of power consumption and candlepower or lumens. This shows how closely the lamps conform to their rated values of watts and efficiency.

3rd, the final and most important test of all, the life test. This involves the measurement of power consumption and light-output at definite periods during the life of the lamps. This test is the only one that reveals the real lamp quality.

In applying these specifications each shipment of lamps is sampled by selecting a definite percentage of the lamps comprising the shipment. The test quantities so selected are tested as outlined in the preceding paragraph. If more than the allowable percentage fails to comply with the requirements of the specifications for any of the tests prescribed the lamps are subject to rejection.

The manufacturing conditions at the factory are inspected at frequent intervals and by the close systematic inspection by the laboratory the purchasers of Hydro lamps are assured of a supply of lamps of uniformly good quality and of such characteristics as to produce economical and satisfactiory service on Hydro circuits.

The Commision with the largest and most complete lamp testing laboratory in Canada at its disposal is in an unique position to maintain the quality of its lamps up to the required standard to the satisfaction of all users of Hydro lamps.

The Use of Electrical Appliances by Utility Employees

The slogan "Do it Electrically" is becoming more and more a by-word in the scheme of things, especially in localities where electrical energy is produced on a large scale and distributed at very low cost to the ultimate consumer.

Electrical appliances are manufactured to-day to perform almost every function in the home and factory which formerly required the hands of the individual to perform and the use of these is spreading with remarkable rapidity through the selling effort being put behind them by the various manufacturers, and central station bodies.

In Ontario we are faced with a problem of promoting the sale of electrical energy through the use of appliances in home and for industrial purposes, chiefly the home, and as distributors of that energy the various Hydro municipalities play a large part in the scheme for distributing appliances either directly or indirectly. Directly by actually engaging in merchandising appliances and indirectly by becoming familiar with their advantages and economies and broadcasting the information, to where it would yield results.

One naturally looks to the central station body for reliable information relating to the operations and economical features of electrical appliances and generally expects the employee with whom contact is made to be fully

informed on all the points about many appliances.

It is reasonable to suppose too that employees of central distributing stations are quite familiar with the various standard appliances as they would be expected to be the first to equip their homes with such devices first to become familiar with their operating properties and secondly out of loyalty to their employer to advertise the product he has to sell. Such was the opinion as regards the employer to advertise the product he has to sell. Such was the opinion as regards the employees of Hydro municipalities until a survey was made of the principal ones to ascertain the facts.

Cards were distributed among the principal Hydro municipalities to be filled in by employes, to indicate what appliances were being used. Out of 490 cards returned the following appliances were shown to be in use:

Irons	487
Toasters	349
Percolators	128
Grills	133
Vacuum Cleaners	203
Water Heaters	35
Dishwashers	1
Air Heaters	159
Clothes Washers	149
Ranges	105
Refrigerators	2
Miscellaneous	20

These results show that a great deal of effort must be put behind sales to our own people before we can expect others to accept the theories and sales arguments used to dispose of electrical appliances.

To further the sale to our own employees, the Commission has instituted the time payment plan on large appliances, similar to that used by most Hydro shops in selling to consumers and every shop will find it necessary, to get the best results, to institute a similar plan if one is not now in operation.

Let every Hydro shop begin the task of educating Hydro employees into the full uses of appliances in the home. If we sell the idea to ourselves, our own enthusiasm for promoting the sale of appliances will increase without measure and the public will place full reliance in the sales arguments used to dispose of such appliances to them.

Choosing the Size Secondary Conductors

By F. T. STOCKING,
Assistant Engineer, H.E.P.C. of Ontario

IN conversation with different individuals who were more or less interested in distribution systems, the writer has been struck with the fact that many did not appreciate fully some of the points governing the proper sizes to use for secondary conductors. Instances have been noted where two No. 6 or No. 4 conductors have fed in only two directions from a 15 kv-a. transformer.

Assuming the most favorable conditions for the above, the loads in each direction would be equal, that is, the load in one direction would be 7½ kv-a. and with the circuit 1,000 feet in length, having the load equally distributed throughout its length, the potential drop with No. 4 wire would be 16.6 volts or about 15%, which, together with transformer regulation of 2.5% and a regulation of transmission line of 5% and step down station of say 2%, would bring the potential at the customers service to about 85 volts unless partly compensated by raising the sub-station voltage by means of transformer taps.

Raising station taps to 10% will raise the potential at the customer's services under the above conditions to 93.5 volts, but during periods of light load will give a potential at the same point of 127 volts. This would be a workable condition although a poor one if the line regulation could be kept at all times within 5% either way, but unfortunately with a system as extensive as that of the Hydro this cannot always be realized. Furthermore at full load the losses will be considerable. The secondary line loss of the above with transformers carrying only about 91% of full load will be about 1.1 k.w. and assuming a diversity of 2 and cost of power to the municipality at $30.00 per h.p. the annual cost for line losses on this secondary circuit will be $22.00. The cost of erecting a third No. 4 wire

on this circuit at present if pin space is available would be about $43.00. With interest, sinking fund and depreciation totalling 13%, the annual charges on this additional capital would be $5.59 while the cost of line losses, if system were perfectly balanced, would be reduced to $5.50, making a total cost of $11.09 as against $22.00 the potential drop on the local circuit would be reduced from about 15% to about 3.75% with no unbalancing of circuit or to 5.2% with reasonable unbalancing which would mean vastly improved although not perfect service.

With the unstable load conditions which obtain over a period of years on the average system it is usually time wasted to consider economical cross section of secondary conductor, the important factor being regulation. As a matter of fact on a 110/220 volt system proper regulation and economical cross section follow very closely and therefore the following discussion is based on regulation only.

In rapidly growing districts it would be unwise to choose a conductor sufficient only for the existing load, especially when the use of appliances is increasing as at present. On the other hand, it is not best to build too much for the future as this might too greatly increase the carrying charges and the expectations of future growth might not be realized. One way of providing for future growth is to begin with a 2-wire system with the idea of running a third wire when occasion warrants but where even a limited range load exists such an arrangement is not satisfactory as the consumer is wired for 3 wires and his fuse and wire capacities are not adequate for the temporary connection.

Where this complication does not exist and when a considerable increase is expected, we might erect say one No. 2 and one No. 4 temporarily with the expectation of eventually using a third No. 2. A two wire circuit with the above sizes would have a carrying capacity about one-half as great as a 3 wire circuit using No. 6 and the cost would be somewhat greater.

Another way of providing for the future is to run what is intended to be a permanent circuit of perhaps double the length that would ordinarily be used with the intention of later using two transformers installed in such positions as to divide the circuit in four more or less equal parts.

The ideal condition for transformer and lead is to have the load equally distributed along the line on each leg of the 220 volt system and with the transformer placed in the centre of this circuit. As this is impossible some allowance must be made for unbalanced conditions. In the following it is assumed that the unbalancing will be such as to produce a maximum load carried by a single circuit leading from a transformer equal to a portion of the total load of the transformer as given below:—

1 circuit 2 wire secondary .... 100% of transformer capacity
2 circuit 2 wire secondary .... 60% of transformer capacity
1 circuit 3 wire secondary .... 110% of transformer capacity
2 circuit 3 wire secondary .... 70% of transformer capacity

3 circuit 3 wire secondary .... 42% of transformer capacity
4 circuit 3 wire secondary .... 33% of transformer capacity

It is of course desirable to keep the potential drop within 2% of full line voltage but this is seldom realized on loaded circuits and 3% has been chosen as the maximum allowable when circuit is fully loaded.

It will be noted that per cent drop has been taken as equal to per cent loss. While these quantities are not the same they are sufficiently close and have been considered in this way to simplify the calculations for the benefit of those for whom this paper is written.

Calculations as well as experience show that 1,000 feet is about the maximum length of secondary circuit that should be run in one direction from a transformer and this is the length of circuit used in the following, although where load conditions are extremely light this distance may be increased with economy and without having excessively poor regulation, where excessively heavy the distance should be reduced.

Using 1,000 feet for all conditions will mean that for light loads the transformer capacity as well as the line conductor will be correspondingly small which is as it should be and give the most economical results. The length of circuit, however, will be more or less governed by local conditions as, for example, it may be impracticable to extend primaries on certain streets thus necessitating a longer secondary circuit in which case the size of conductor should be correspondingly increased to avoid excessive line drop.

Assume a load of 5 kw. transmitted at 220/110 volts approximately equally in two directions. Probable maximum load in one direction 70% of 5 kv-a.=3.5 kv-a. If this load is equally distributed along the 1,000 feet of line the voltage drop may be assumed as equivalent to the load carried one half the distance, or 500 feet, and the size of conductor necessary to keep this drop within 3% or 6.6 volts will be found as follows:

Current, denoted by C, equals 3,500÷220=15.9 amperes.

According to the old formula C multiplied by the resistance equals volts drop or, in this case 6.6 volts, therefore we are to choose a conductor of a size having a resistance of 6.6÷15.9=.415 ohms. in the length of wire over which the current flows which in this case is 2×500(measuring to centre of distribution)=1,000 feet for the return circuit. The resistance per 1,000 feet of No. 6 is .388 hence No. 6 will be suitable for this circuit as for mechanical reasons this is the smallest that should be run. If the transformer is placed near a corner so that it can feed in four directions instead of in two, and if the loads in each direction are approximately equal then the current of a 10kv-a. transformer can be taken care of by a 3 wire system using No. 6 conductor but a permanent distribution system should not be planned using No. 6 wire with a transformer of greater capacity than 10 kv-a.

For a 2 wire system with a 3 kv-a. transformer feeding in two directions we may assume, when the loads in

each direction are about equal, that the maximum carried in one direction is 60 per cent of the capacity of the transformer or 1.8 kv-a. and the current flowing will be 1,800÷110=16.4 amperes. The permissible drop is 3% of 110 equals 3.3 volts and ohms resistance in 1,000 feet of line should be 3.3÷16.4 or .202. The resistance in 1,000 feet of No. 4 is .244 of No. 2 is .153 hence No. 2 should be used. Here we come to a matter of expediency. Such an installation is usually made where the business is poor and the revenue to be expected would not warrant a heavy outlay while the probability of heavy overloads is small and in consequence No. 6 would ordinarily be installed, although a third No. 6 would be preferable in every way.

Where a 5 kv-a. transformer is used feeding equally in two directions on 2 wire system the current in each direction may be assumed as 27.2 amperes, which would bring the allowable ohms resistance calculated as above to .121 ohms. No. 2 has resistance per 1,000 feet of .153, No. 0 of .096. Unless this was placed in a district that was growing rapidly and where it was expected that within a comparatively short time the district would grow to proportions sufficient to warrant a 3 wire system of No. 0 conductor No. 2 or smaller would be used.

It is obvious from the above that nothing but a 3 wire system should be used where the transformer capacity is greater than 5 kv-a. as a 2 wire system would run into too great expense for conductor, and this rule holds in spite of the fact that the 2 wire system avoids unbalancing of load on lines and transformers.

Below is Table showing sizes of conductors based on similar calculations under various load conditions, the proportion of load which might occur on a single circuit to the load of the transformer being taken as follows:—

1 Circuit, 110%, 2 Circuits 70%, 3 Circuits 42%, 4 Circuits 33%.

Sizes of Conductor on 110/220 Volt System to Give Potential Drop of 3%.

Transformer Capacity kv-a.	1 Circuit	2 Circuits	3 Circuits	4 Circuits
3	No. 6	No. 6	No. 6	No. 6
5	4	6	6	6
7½	4	4	6	6
10	2	4	6	6
15	0	2	4	4
20	000	0	2	4
25	000	00	2	2
30	0000	000	0	2
40	300 M.C.M.	0000	0	0
50	350 M.C.M.	250 M.C.M.	000	0

The sizes as given above are for the 220 volt conductors but the neutral wire may be one or two sizes under those given excepting when the conductors are very large, in which case No. 0 will be ample for neutral on any ordinary lighting circuit.

As already stated the above is subject to local conditions such as quality of load to be supplied and the probability of the load either increasing or decreasing, but an endeavor should always be made to so proportion conductors and transformers as to make them suitable for each other.

Since as intimated above the economical cross section happens to be about equal to the size that will give 3% drop on a 110/220 volt circuit 1000 feet long and as the economical cross section of a conductor holds the same for a given load regardless of length of circuit the sizes as given above will be about correct to use even though the circuit is shorter than 1000 feet.

Ontario Hydro-Electric Club Picnic

The Second Annual Picnic of the Ontario Hydro Electric Club was held on July 13th at Grimsby Beach. About 650 took the boat trip and 200 others motored over from Toronto, Hamilton, St. Catharines and Niagara Falls. The park was almost completely given over to Hydro employees and their friends for the day and most of the Provincial Hydro offices in Niagara peninsula were closed for the occasion.

Sir Adam Beck, Chairman of the Commission, was an active participant in the proceedings and treated the youngsters to a fine display of horsemanship on one of the park ponies.

In the baseball game between Niagara and Toronto offices the Niagaras won a hard fought battle by a score of 8 to 5.

Toronto Office played Hamilton in a soft ball fixture and plastered a 26 to 5 defeat on them in retaliation for the loss of the game a week earlier.

The handsome prizes donated were keenly competed for, with a large number of entries in each event. The ladies participated to a greater extent than usual and two or three heats were necessary for every race.

The Baby Show brought out a large number of entries and the judges had a difficult task to pick the winners.

The Hydro Orchestra provided music for dancing on the boat morning and evening and a clown kept the kiddies amused all day long.

The following committee chairmen had charge of the various activities:

Mr. G. O. Vogan—President of the Club.

Mr. J. P. Morgan—Publicity and Entertainment.

Mr. Don Carlos—Refreshments.

Mr. Art Rice—Sports.

HYDRO NEWS ITEMS

Central Ontario System

Applications for 80 h.p. for industrial uses have been received by the Bloomfield Hydro-Electric System.

The new development at Ranney's Falls, Dam No. 10, on the Trent Canal System, is expected to go into operation at once.

RURAL

A meeting was held in Sidney Township and a canvass is being made as a result of this meeting, to cover the Provincial Highway, West of Belleville.

Two meetings have been held and active canvasses are being carried on in Harrowsmith district.

A line to serve Cataraqui Village and the surrounding district from Kingston will be built this season.

Niagara System

The Commission has recently approved of an additional debenture issue of $100,000 for the Niagara Falls Hydro-Electric System to take care of extensions and improvements to the local plant. The Niagara Falls System has shown a remarkable growth in connection with domestic service during the past year.

The new sub-station and office building will very shortly be ready for service.

It is expected that the Walkerville Hydro-Electric System will have their new office building ready for occupation some time in the month of September, and that the formal opening is to be an affair of considerable local importance.

The municipality of Port Dalhousie has recently received approval for the issue of $5,000 additional debentures to take care of extensions and improvements to the local System.

Work will shortly be commenced in connection with the 26,000 V. line from the Commission's Essex High Tension Station to Belle River. An outdoor type sub-station will be erected at Belle River to supply the municipality. The construction of a system in Belle River will be taken care of by the Construction Department of the Commission. Arrangements have also been made for the construction of the rural district adjacent to Belle River. The construction of rural lines will be carried on at the same time as the village system is being constructed.

Arrangements have recently been made for the construction of a rural

Toronto Power Company, Generating Station, from the South

distribution system in the Beamsville district to supply approximately 400 rural consumers. Power for the district will be transmitted at 12,000 V. from St. Catharines and stepped down at an outdoor sub-station. The 12,000 V. line will also be extended to Grimsby to supply an important power customer who has recently signed a contract at that point.

Rideau System

Trade depression does not appear to have had any considerable effect in reducing the load on the Rideau System. In the towns of Carleton Place and Perth there are several flourishing woollen mills, which have been running to nearly full capacity for the last few months.

About 18 months ago the woollen industry was in low water and orders were coming slowly but lately things have improved very considerably.

The Greenville Crushed Rock Company, which is located between Merrickville and Kemptville, is still supplying large quantities of crushed stone for the C.P.R. and they have still in sight two or three years' supply of rock. They have completely discarded their old steam plant and are now taking 400 h.p. from the Commission.

The municipality of Kemptville is learning the advantages of obtaining a power supply using properly designed apparatus, new distribution system, etc. The old company used to overload their 250 k.w. generator to supply this village, but under Hydro their maximum peak has not exceed 120 h.p.

The installation of meters in opposition to the old flat rates has, of course, greatly assisted in obtaining these results.

The Kemptville Milling Company, who previously supplied the municipality with power, has brought two lawsuits against the municipality asking for arbitration between the company and the municipality, but in both cases the court has decided in favour of the municipality with costs against the company. As a final effort, however, the Kemptville Milling Company are now sueing the town of Kemptville for $46,000.00 damages done to their property by the town in erecting a new distribution system. The municipality takes the stand that this company has no franchise, or any rights whatever, on the streets of the village.

St. Lawrence System

The Prescott Rural Power District, including the village of Spencerville, is at last appreciating the benefits of Hydro-Electric Services. We have now 66 contracts on this 12 miles of rural line and one consumer is erecting a large saw-mill in the village of Spencerville with the intention of installing a 40 h.p. motor to run a 50-inch saw, planer and other wood-working machinery. This man has been considering the erecting of a saw-mill in the village but before the advent of Hydro-Electric power found it impossible to do so.

The village of Cardinal has requested this Commission to submit an estimate on the cost of supplying electric energy to the municipality.

The Council of the Township of Lancaster has forwarded to this Commission two petitions from rural residents requesting an estimate on the cost of supplying rural residents of the township.

Lancaster Township in Glengarry County is in the east end of the Province of Ontario, having for its eastern boundary the Township of Nouvelle Longneuil of the Province of Quebec.

Operating Department Picnic

The Operating Department Staff of the Ontario Hydro Commission held their annual picnic on July 8th. About one hundred and twenty-five employees and their families from Toronto, Hamilton and Dundas enjoyed the outing. In accordance with the Operating Department custom, one of the beautiful sites on the Commission's Right-of-Way was taken advantage of as a picnic ground. The spot chosen this year was on the Transmission Line Right-of-Way where same crosses Twenty Mile Creek, north of Oakville. An "ideal country road" led into the property.

During the afternoon games and races were held for which some interesting prizes were awarded. A game of soft ball between the men of the Hamilton Office and field against Toronto created a great deal of excitement by reason of the interest displayed by the Hamilton rooters led by Mr. Geo. G. Terry, more so than by any brilliant display of talent by the Hamilton team. The referee, a Field man, after giving Mr. Don Carlos and his followers and Mr.

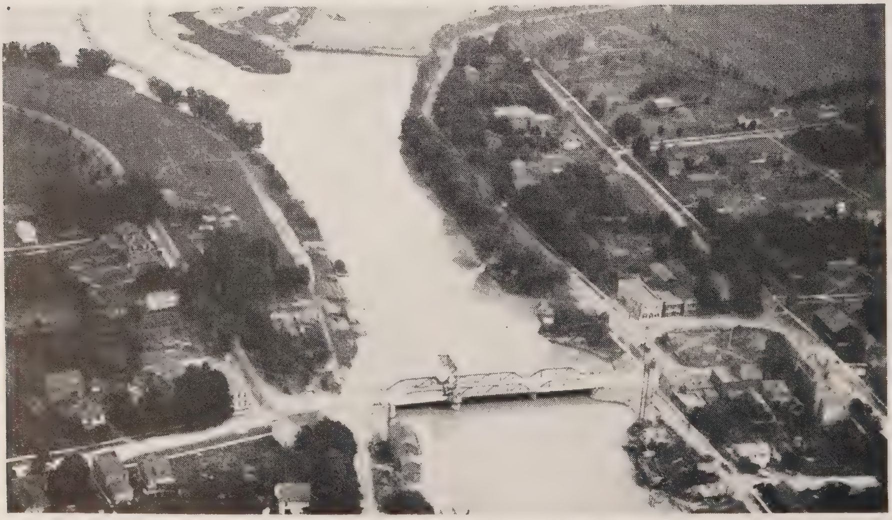
Terry and his contingent the "'once over" decided one point in favor of Hamilton due to preponderance of both weight and numbers of the Hamilton team, who were also fellow workers. Toronto took it smiling and silently understood.

In order to pile up additional honors the Hamilton girls brought along a "dark horse" in the person of a young lady from Dundas, captain of the champion team of Canada for girls' indoor baseball. The Hamilton girls with this experienced pitcher quite naturally defeated the rank amateurs from Toronto.

In the men's Tug-of-War, Toronto's end of the rope was quite "accidentally" fastened to a tree stump. This left the result in doubt and upon pulling the event over again Toronto very generously allowed Hamilton to win. In the ladies' Tug-of-war the Hamilton end of the rope was very intentionally anchored to a real live anchor which the Toronto girls failed to budge.

Mr. Terry's incomparably jealous guard over all decisions of events in which Hamilton people took part certainly merits him a large percentage of credit for everything they won.

A very capable committee with Mrs. Vanzant in charge of the supper assisted by Miss Anderson and Mrs. Dandeno of Toronto and Miss Back of Hamilton, Mr. Dandeno in charge of sports assisted by Messrs. Sharp, Lawson and Wills, were responsible for a splendid outing.



THE BULLETIN

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Commissioner
Fred H. Miller
Deceased, August 30th, 1922

CONTENTS

Vol. IX. No. 7.

SEPTEMBER, 1922

The Late Fred H. Miller

In the death of Mr. Fred Miller, the staff feel that they have lost, not only an able Commissioner, but a real friend as well.

Endowed with the genius of common sense, and the happy faculty of making those with whom he came in contact, feel at their ease, he was beloved by all, from office boy to the highest official. In personal character he combined dignity and urbanity. An unusually large circle of friends testified to his great personal popularity; he never forgot one of them and was best loved by those who knew him best for his extremely sociable, friendly and humane qualities.

The many interests with which he was identified testified to a busy life; he was essentially a builder and a worker, an ardent believer in the great work of the Hydro and steadfast and true in his loyalty to the Chairman, who, with the rest of us, will feel his loss so keenly.

"Tired he sleeps;
And life's poor play is o'er."

E. C. S.

Re Murray Report

In the March-April (1922) number of the Bulletin we published a "Summary of Reply to Murray-Flood Report." This reply has since been printed in book form under the title "Refutation of Unjust Statements," and is available for general distribution.

The "Murray Report" was published and circulated by the National Electric Light Association and bore the title "Government Owned and Controlled Compared with Privately Owned and Regulated Electric Utilities in Canada and the United States."

In the reply it is shown that the Murray Report is but another attempt by an organization opposed to Public Ownership to strengthen its own position by manufacturing a report showing wherein the Hydro-Electric Power Commission is falling down. By use of a series of errors, omissions, exaggerations and misrepresentations the Report was made to appear as intended. To one not conversant with the work of the Commission it would appear as if Mr. Murray was right although his conclusions are at complete variance with the fact.

In view of the special and widespread publicity given to the Murray Report, it became desirable to issue this authorative statement in reply.

* * *

Duplication of Electric Motors

It has been pointed out that in choosing motors for the operation of a factory, care must be taken to keep the number of sizes and speeds down to a minimum so as to permit insofar as possible the interchange of motors and starters in case of breakdown. Our attention is more particularly directed towards seeing that this provision is made in reference to certain key machines in the plant. Such a policy is in the right direction for the economical operation of the factory in that it will reduce to a minimum losses due to long shut downs while repairs can be affected, and also the amount of capital that would be tied up in reserve equipment.

Where the electrical supply is alternating, the question of power factor must not be overlooked. This puts a limitation on the size of a motor that may be used for a particular purpose. In choosing the motors for the original layout care must be taken that they will operate at the highest power factor possible. Where the system of rates for power uses a penalty for low power factor, the amount of such penalty must be considered when studying the economics of the layout. It is quite possible that by installing a group motors of too great capacity to avoid the purchase of an additional spare, that the power factor penalty resulting in the power bills will more than pay the carrying charges on that spare. Similarly when it is desired to overmotor a certain location to provide a motor that may be used on some key machine that the power factor penalty together with the loss of product and other increased charges resulting from such an installation will more than compensate for the cost of carrying a spare motor of the proper size for the key machine.

* * *

What Made It Work?

Mr. J. R. Smith tells us of a test made by him in conjunction with Mr. King and Mr. Pew of the Ontario Power Company, in which with the aid of a piece of home-made apparatus they were able to locate the exact point at which an underground cable had failed, although there was apparently no current flowing through any part of the cable at the time.

Mr. Smith does not advance any theory as to why they should get the results they did, but has left the reader with a question in his mind.

The phenomenon described is very unusual and opens up a subject suggestive of discussion. Some of our readers have no doubt made a study of phenomena similar to that described and can give their reasons for what occurred in this particular case.

Galt Municipal Transformer Station

IN the previous number of the Bulletin we gave a short description of the new office and sub-station building of the Galt Public Utilities Commission. It gave a general idea of the manner in which the equipment was placed in the building, but did not treat of any of the special features that were worked out. Some of these are of special interest both as regards the general design and also as to operation.

All equipment in use is standard apparatus, which was purchased and installed following suggestions of Mr. Elliott, in consultation with the Engineers of the Hydro-Electric Power Commission. Although the station will operate for the present at 13,200 volts on the high tension side, yet all equipment used has been designed and installed for 26,400 volt operation, and will therefore require but a few minor changes in connections when the voltage is increased to the greater amount.

The incoming lines are brought to a structure located on the roof of the building from which they pass through standard wall bushings into a penthouse. Here the leads are carried downward to the sub-station wiring. By placing the incoming disconnecting switches and kicking coils below the penthouse, ample air space is provided for these details. The windows which are operated from the floor of the high tension room add to the lighting and ventilation.

The arrangement in the high tension switch room shows an entire absence of obstructions. This has been accomplished by suspending the pipe work for supporting busses, wiring and disconnecting switches from the roof structure. In this manner all pipe structures carried from the floor have been eliminated.

The same absence of obstructions is to be noted also in the low tension switching room, the only supports carried from the floor being those for breakers have been arranged, two to each cell, which has further simplified the layout. All supports and switch frames have been painted grey, which improves the general appearance and assists the lighting. Barriers have since been installed between the disconnecting switches of each feeder.

An unusual feature is to be found in the cable work, in that, no cable crossings are made anywhere where imbedded in the concrete of the floors. All conduits are carried to terminal boxes built into the partition at the back of the control board, and all cable crossings are affected at these points.

In the low tension wiring there is a double bus arrangement which will permit putting the load or any portion of it on any transformer or group of transformers as may be desired.

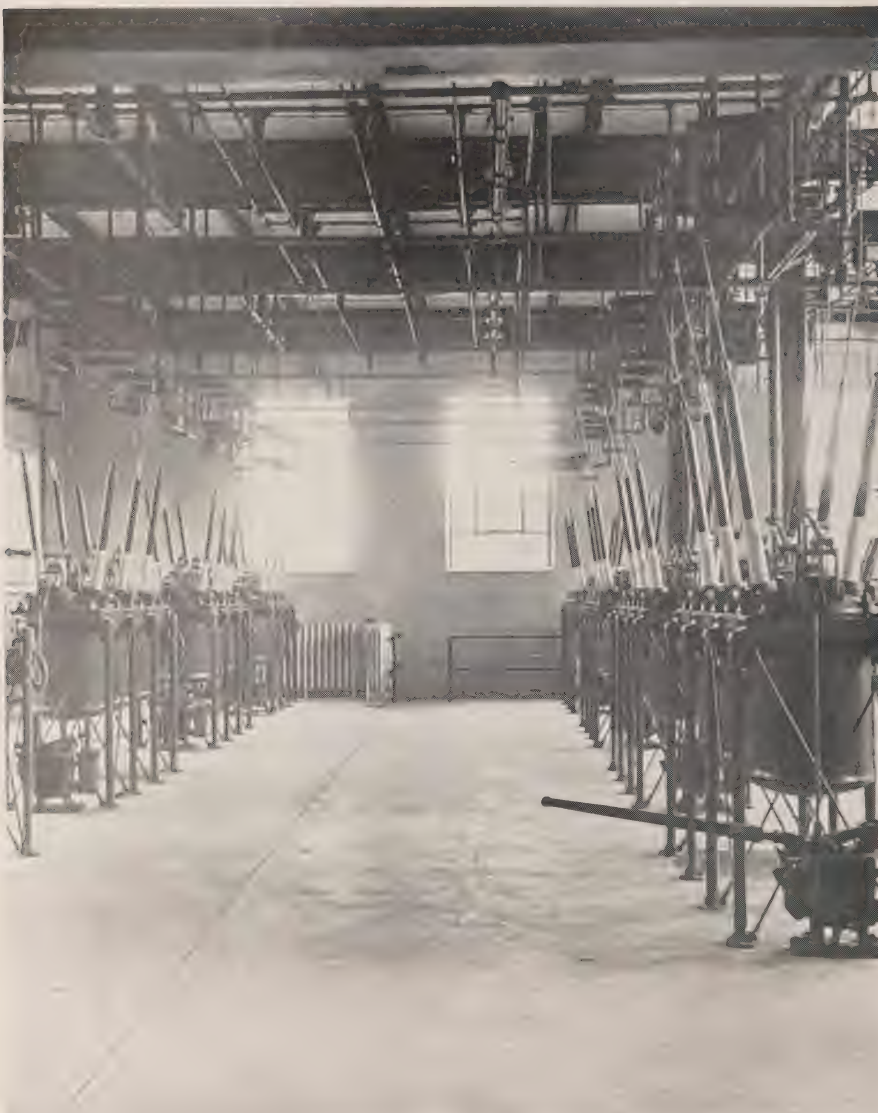
All circuit breakers are normally electrically operated from the control board. This is provided with dummy busses and each control switch with pilot lights. The control panels are

26,000 Volt Entrances and Lightning Arresters

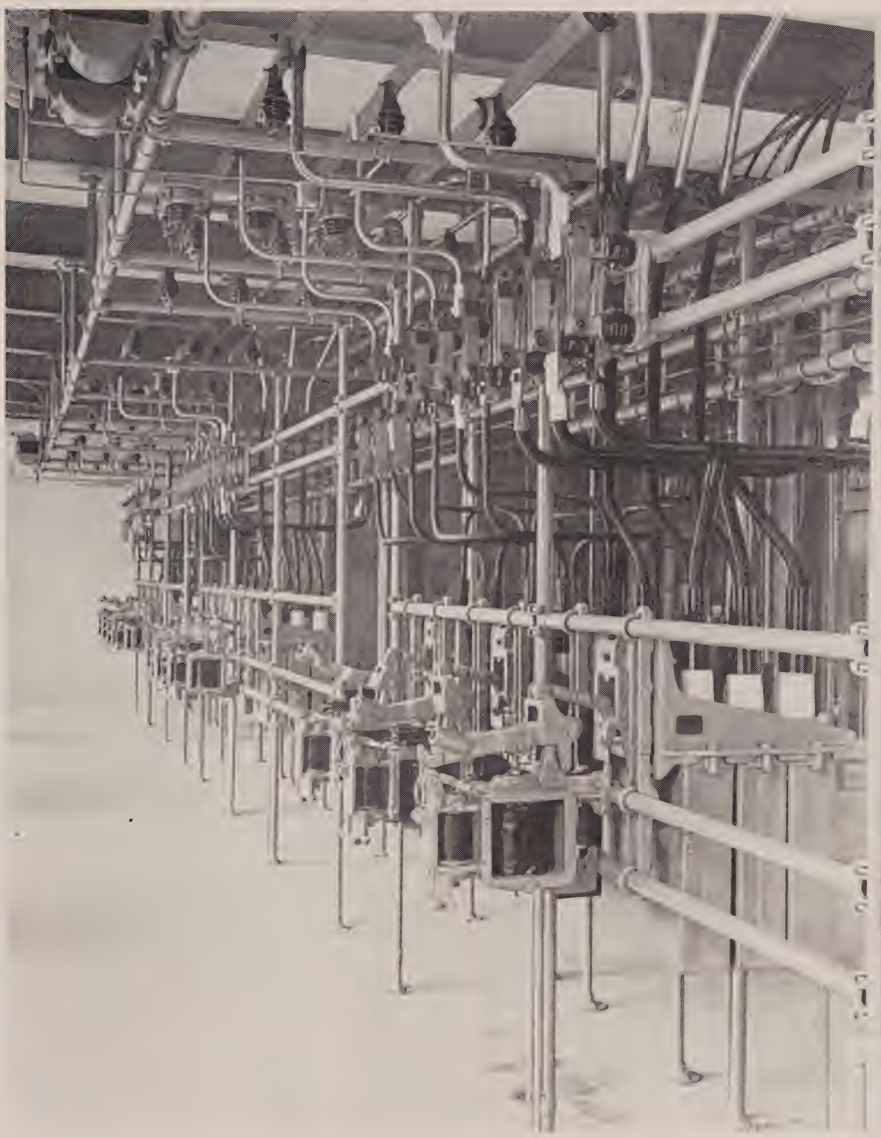
held at the top by pipe supports to the girders above, the supports being placed at an angle of 45 degrees. The test blocks on the back of the board have been placed about two feet above the floor.

The street lighting panel contains a feature which is worthy of special comment. In the early days of Hydro operation in Galt the Local Commission experienced a serious loss in street lamps during a winter storm.

During the day the snow had collected on the lamps, and when they were turned on in the evening a large number of them broke. Mr. Elliott conceived the idea of keeping the lamps warm during such weather, and therefore installed another switch on the street lighting panel so arranged



'6,000 Volt Switching and Bus Details



2,300 Volt Switching and Bus Details

that a low voltage can be applied to the street lights during the day and supply enough heat to keep the lamps dry. The arrangement has prevented any further loss of street lamps in this manner.

Leaves from an Inspector's Note Book

By "ANODE"

A POINT to which sufficient importance is not paid by users of electrical machinery is that of duplication, and if this were more often considered when installing additional machines, or replacing old ones, a deal of trouble and manufacturing losses would be saved.

In the course of my travels I have dropped across numerous cases where it would have been possible by a slight additional expenditure to duplicate an important key machine, yet the opportunity had been neglected, with the result that on a breakdown of the key machine, the whole of the works had perforce to stop, whereas, had a duplicate been available, it could have been installed in the place of the faulty machine, and the probable result would have been that the output of the works would not have been seriously affected.

An instance of this occurred some years ago, in a small foundry, where the key machine was a 30 h.p. motor driving the blower. No other motor in the place was of anything like the power, and the firm did not feel like going to the expense of buying a duplicate, which probably would have remained idle for a lengthy period.

I urged upon the owners the advisability of making some arrangement to ensure that in the event of a breakdown they could carry on, but without avail, until one day, when I was making my customary inspection, they asked my advice as to purchasing a motor for an extension of their works.

The maximum horse-power required would be 20, and that very seldom, and their idea was to install a 15 or 16 h.p. motor conservatively rated, and rely upon its overload capacity for the exceptional instances when the 20 h.p. would be required.

The opportunity was too good to be missed, and I put forward the suggestion that it would be advisable to duplicate the blower motor; even though it would cost more than the 16 h.p. machine, it would consume very little more energy, and in the event of a breakdown of the blower, they would not have to close their works for any lengthy period, as two hours would suffice to change over the machines.

After a lot of discussion they decided to do this, and having gained my point, I went a step further and suggested that they should also duplicate the starting switch, which was arranged for speeds above and below normal. This was also agreed to, and the necessary particulars, together with the order, were duly dispatched to the motor manufacturers. The firm was then in the position that in the event of a breakdown of either the motor or the starter, it could get going again immediately, and further

that the motor working in the new extension would be running on an easy load, and capable of dealing with the occasional 25 per cent. extra load without difficulty, and still leave a reserve of power available if any extra were required.

A few months later, at a time when they were exceptionally busy, the blower motor completely burnt out, necessitating rewinding of both armature and fields, and the change-over to the duplicate was made; it was found that the total loss of output was 15 per cent., whereas had this duplicate not been available, it would have taken as long to obtain another machine as to rewind the burnt-out one, and for that period the whole of the output would have been lost. This afforded a striking example of the value of even a partial duplication, and there are many instances where something on similar lines could be arranged.

It is not always the case that the largest machine in a works requires duplicating, as the following instance will show:—

A large works had an electrical installation second to none in the kingdom; all the machines were standardised and so arranged that practically any motor could be replaced at once, and in addition they had at least 50 per cent. of the armatures duplicated, so that it appeared impossible for any breakdown to cause more than a very brief stoppage.

On going around these works I was greatly impressed with the admirable arrangements of the whole installation, yet there was a cockroach in the jam.

The generating plant consisted of two large high-speed sets, one of which worked at a time, and of ample capacity for the whole requirements of the works, yet only one condenser pump motor was installed for both sets, and this was the only motor that was not duplicated, no motor of the same size and speed being available in the works.

In the event of this motor breaking down, the position would have been very awkward, and on my pointing this out to the managing director he was greatly surprised, and immediately put a spare machine on order.

It would certainly have been possible to work the sets non-condensing, but the loss would have far outweighed the cost of the small motor.

It is not always so easy to advise clients as in the two instances related, as in some cases where firms adopt a penny-wise policy, one finds an installation of perhaps 60 motors representing a dozen different makes and all of different powers and speeds.

One happy-go-lucky firm of this sort on one occasion had a breakdown to a 25 h.p. machine, and was forced to substitute a 15 h.p. motor, this being the only one available near the speed required, and to work on half the plant for a week or two, a serious matter during the war, and still more serious from the point of view of munition supplies.

This taught the owners a lesson, and when they extended their works, the electrical portion received very careful attention, the new plant being so arranged that not only was it standardised, but it duplicated a fair portion of the older plant as well.

It is not only the motor that requires duplicating; it should always be possible to replace a defective starter, and it is common knowledge that there are some thousands of these to be found all over the country.

I suppose the history of the motor-starting switch is something like this: When the first man made a motor he found that it was not lucky to start it by closing the main switch, especially when the motor was of any size, so he made a graduated resistance which went in series with the motor, and gradually evolved something on the lines of a multiple switch, which took the place of the old main switch as the starting device.

This went on till one day the generating station broke down and the motor stopped; the resistance, of course, being cut out. The generating station got going, and the poor motor got the lot suddenly, with disastrous results.

Then the brainy man designed a no-volt release, which acted sometimes, and more often did not.

The next thing was that the motor got overloaded, so he set to work and designed the overload release, that beastly little thing made out of hair-pins and odd brass strip, which acted, or was supposed to act by short-circuiting the no-volt coil.

After thirty years we find the same device stuck in the south-west corner of the starter, and still as profanity-provoking as it was in the beginning.

Then the cheap-jack took a hand in the deal, and cut down everything to the finest limits, and turned them out by the thousand, and at such a price that when you bought a motor, a starter was thrown in like over-weight margarine, and 75 per cent. of the motors running to-day are controlled (?) by these rotten cheap starters, with the result that 50 per cent. of the motor breakdowns are directly caused by them.

It is to the credit of a few firms that this state of affairs is being altered, and they have succeeded in turning out absolutely reliable control gear and I find that the leading engineers are paying great attention to this question of control, in many cases the control gear costing more than the motors it works in conjunction with.

Electrical Review—August 18, 1922.

Locating a Fault in an Underground Cable

By J. R. SMITH,
Assistant Engineer, H.E.P.C. of Ontario

FAULT detectors of various kinds have been developed and have been placed on the market, each of which has its peculiar method of operation in locating the position of a fault in a cable or transmission line. We do not wish to treat of any of these, but will confine ourselves to a description of the actual conditions wherein a fault in an undeground cable was definitely located by what is believed to be an unusual form of detection.

A ground had developed in an underground section of one of the Commission's rural lines due to a direct lighting discharge on the overhead system. Figure I. shows diagrammatically the connections at the point where the line changed from overhead to underground for that particular section. The overhead line consists of three No. 6 conductors and a ground wire, operating at 4,000 volts. Disconnecting switches are located on the second pole back from that on which the line changed from overhead to underground. On the first pole back there are three lightning arresters ground by a separate wire running down that pole. The line ground wire is attached to the lead sheaths of the underground line just below the potheads. The underground section consists of three conductors, each having its own lead sheath, all carried down the same pole and laid in the same trench.

Carried on the same poles on brackets are three D.B.W.P. wires at 110

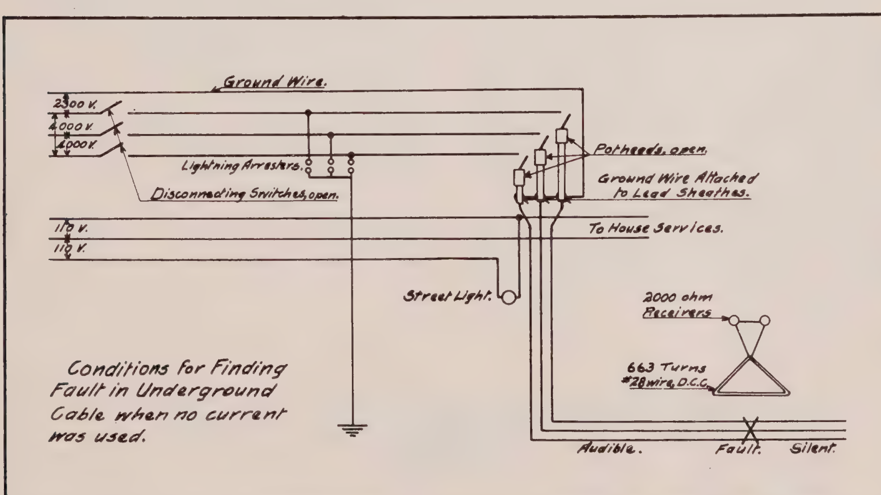


Figure 1

volts for street lighting and service to houses. These are supplied from a transformer located on a pole back from the disconnecting switches. The last street light is located on the pole carrying the potheads. The 110 volt service wires leave this same pole at an angle of about 45 degrees, passing through trees but not insulated from them, except by the weatherproof covering.

The fault detector is a home made piece of apparatus consisting of a coil and a pair of 2,000 ohm. telephone receivers. The coil is triangular in shape, 30 inches on its base and 18 inches in height, roughly honeycomb wound of 663 turns of No. 28 double cotton covered wire, the coil being encased with friction and cotton tape. The ends of this wire are brought out at the top where taps are provided to allow of any number of turns being connected. In this case all turns were connected in series with the telephone receivers.

When the test was made, the disconnecting switches were opened as also the potheads, making all three underground cables dead. When the coil was placed over the underground conductors, the telephone receivers gave a pronounced hum. This hum was oscillating, increasing and decreasing in volume, having a regular period. As the detector was carried along the route of the underground line the sound continued up to a point about 100 feet from the point where it entered the trench. Beyond this point the receivers were silent.

The cables were dug up at the point where the detector became silent and it was found that all three had broken down at this location.

By this simple piece of home-made apparatus, we were therefore able to fix definitely the location of a fault in the underground cable although apparently no current was passing through it at the time. The line disconnecting switches had been opened as also the potheads, nor were there any lines of any kind paralleling the defective underground cable at the location where the test was made.

No attempt has been made to explain the electrical phenomena that permitted the location of a fault in this manner, but the conditions as they actually existed have been given.

By the usual methods of fault finding a potential is applied to the defective cable and the location of the fault ascertained either by measurement or by listening for inductive action along the line. In this case, however, no current whatever was used.

Association of Municipal Electrical Utilities

MINUTES OF MEETING OF EXECUTIVE COMMITTEE

The meeting was called to order at 2.30 p.m. on Tuesday, September 5th, 1922, at the office of the Hydro-Electric Power Commission of Ontario.

Those present were, Messrs. M. J. McHenry, President; J. J. Heeg, W. E. Reesor, P. B. Yates, O. H. Scott, A. T. Hicks, R. H. Staford, E. J. Stapleton, H. F. Shearer, G. J. Mickler, R. T. Jeffrey, L. G. Ireland, and S. R. A. Clement, Secretary.

It was moved by Mr. O. H. Scott and seconded by Mr. A. T. Hicks: That the minutes of the last Convention be adopted as published.

CARRIED.

The Secretary referred to correspondence with Mr. F. Gover, Secretary-Treasurer, Orillia Water, Light and Power Commission, in reference to holding the Summer Convention at Orillia next year. It was suggested that the Convention be held at Orchard Point Inn as being more convenient and suitable than the Y.M.C.A. at Geneva Park. He also referred to a visit to Orillia for the purpose of looking over the proposed location and reported on the facilities as he found them for holding a Convention. Mr. Gover was present and gave further information regarding accommodation and suggestions for entertainment as proposed by the Orillia Commission.

It was moved by Mr. J. J. Heeg and seconded by Mr. R. H. Staford: That this Executive recommend that the next Executive consider the proposition of holding the next summer Convention at Orillia. CARRIED.

Plans for the next winter Convention were then considered.

It was moved by Mr. A. T. Hicks and seconded by Mr. W. E. Reesor: That the next Convention of this Association be held at Toronto on January 25th and 26th, 1923.

CARRIED.

It was suggested that during Conventions, less time be given to reading of papers and more to the discussions also that we ascertain from the membership, subjects they would like taken up.

It was moved by Mr. O. H. Scott and seconded by Mr. A. T. Hicks: That a questionaire be sent out asking for suggestions for papers and subjects to be discussed.

CARRIED.

It was moved by Mr. P. B. Yates and seconded by Mr. H. F. Shearer: That the Secretary look into the question of having hotel headquarters for the Convention, and include in the questionaire the question whether delegates will stay at the hotel.

CARRIED.

Referring to the question of expenses arising out of the commercial exhibit, it had been suggested that the Association stand this expense and not bill it to the exhibitors as had been done formerly.

It was moved by Mr. P. B. Yates and seconded by Mr. O. H. Scott: That the expenses of the commercial exhibit be billed to the exhibitors.

CARRIED.

The Treasurer was asked to prepare a detailed statement of the finances of the Association and present the same at the next meeting of the Executive Committee. The meeting then turned to a general discussion of merchandising as between the Utilities and the Hydro-Electric Power Commission after which it adjourned at 5.00 p.m.

* * *

MINUTES OF MEETING OF COMMITTEE ON ACCIDENT PREVENTION AND HEALTH PROMOTION HELD AT THE OFFICE OF THE HYDRO-ELECTRIC POWER COMMISSION, ON TUESDAY, JULY 4TH, 1922.

The meeting was called to order at 2.30 p.m. by Mr. A. T. Hicks, Chairman. Others present were Messrs. Wills Maclachlan, F. F. Ambuhl, P. Powell, C. E. Schwenger, T. C. James, W. H. Mulligan, A. G. Lang, R. T. Jeffrey and S. R. A. Clement.

This was a postponed meeting that had been called at the Clifton, Niagara Falls, on June 22nd, for the purpose of discussing with representatives of the Hydro-Electric Power Commission, the question of making a periodic inspection of municipal distribution systems.

The first question taken up was the matter of penalizing employees for not using rubber gloves and other proper safety appliances when the same were necessary. The following resolution was carried.

"That when an employee deliberately disobeys the standard rules or instructions of the man in charge in regard to safety, that he be penalized by being laid off for a minimum of two weeks without pay."

Proposed rules for the installation and maintenance of electrical supply and signal lines as gotten out by the Hydro-Electric Power Commission were discussed, reference being made to the National Safety Code.

It was recommended that the Executive be asked to take up with the Canadian Electrical Council the matter of appointing a sub-committee to deal with this matter and that Messrs. Schwenger, Lang and Maclachlan be appointed a sub-committee of this committee with power to add thereto and inquire into the rules and bring in recommendations.

With reference to the inspection of distribution systems, Mr. Jeffrey reported that his department was in a position to make such inspection as is required, and wished the Association to give proper backing that recommended changes be enforced. The following resolution was carried.

"This Committee recommends that the Hydro-Electric Power Commission of Ontario, take such steps as may be advisable under the Act, to see that recommendations regarding changes in lines and stations considered necessary to be made by representatives be made, which may be found necessary for the safety of workmen and the general public according to the standards of construction as adopted from time to time."

Mr. Powell suggested that recommendation come from this Committee and pass on to the municipalities to start some movement for employers to have the local medical health officer address employees and also to take advantage of various health bul-

letins published. This matter was left over until the next meeting.

The meeting then adjourned.

* * *

Meeting of Severn System Municipalities

A meeting of representatives of all the municipalities on the Severn System was held at Barrie on Tuesday, July 25th, at which were present representatives of various departments of the Commission for the purpose of discussing with the various delegates matters pertaining to the operation and administration of the System in general, as well as various problems confronting each individual municipality in the maintenance and operation of each particular individual system.

At the close of the meeting an organization was formed to be known as "The Hydro Electric Association of the Severn System Municipalities," and the following officers were elected:—

President—Mr. J. H. Bennett (Chairman, Water & Light Comm'n, Barrie).

Vice-President—Mr. W. J. Holden (Mayor of Collingwood).

Secretary-Treasurer—Mr. S. J. Milliken (Secretary, Public Utilities Com., Midland).

Executive Committee—Mr. T. A. Chapman, Beeton; Mr. J. H. Mitchell, Alliston; Mr. J. E. Prentice, Collingwood; Mr. M. S. Brandon, Tottenham; Mr. J. B. Jennings, Penetang.

The new Association proposes to function along similar lines to the organization formed by the Eugenia System municipalities at a meeting held in Durham during the month of May, details of which were reported on in a recent number of the Bulletin.

Before the meeting adjourned, the following resolutions were passed unanimously:—

"We, the representatives of the Hydro municipalities of the Severn System of the Hydro-Electric Power Commission, do condemn, in the strongest terms, any newspaper or newspapers that publish statements in regard to the workings of the Hydro-Electric Power Commission, or local sub-commissions, without first ascertaining the facts, as erroneous statements so published are exceedingly detrimental to the working out of the system to the advantage of the people, and we commend, in the warmest terms, any newspaper or newspapers that publish the actual facts in connection with the workings of the Provincial Commission or any local commission."

"We, the representatives of the Hydro municipalities of the Severn System of the Hydro-Electric Power Commission, wish to express our thanks to the Chairman, Sir Adam Beck, and his colleagues on the Hydro-Electric Power Commission, in sending these men here to talk over matters with us, and we think it would be to the advantage of the Commission and the municipalities to have more heart to heart talks, so that the municipalities may become better acquainted with their own system, and the public become much better and more fully acquainted with the facts than they actually are."

* * *

Technical English as She is Wrote

A very precious gem of technical English was recently discovered in an Ontario daily. The lucid explanation of "volts" is so clear that to add anything would be to gild refined gold or paint the lily. Read it yourself and see.

The Bulletin thinks that Mr. Catton owes it to his friends to explain what he really did when he so thoroughly bamboozled the reporter.

"DISSECTING THIS GIANT POWER"

"There were six holes in a brick wall; through which entered, passing along copper wires encased in pipes, 26,000 units of power. They are called "volts," and volts means leaps or bounds. 'Leaps' of power; but the bounds are so speedy that practically the power pressure may be said to be unbroken in the direct current.

These rapid leaps of energy we have named electricity, simply because the Latin electrum, which we call amber was the medium in which this power or current was first observed. When the line conveying this energy is divided, under given restrictions in jumping the intervening space, light and heat or light or heat, are given off. When speaking of Hydro-electric power, no thought is conveyed of water forming any part of the electricity, but only the falling or sweeping of the water from a higher to a lower level providing the power or energy which is scientifically converted into electricity.

How this power is 'harnessed' according to the task it is called upon to perform, is too intricate for the uninitiated. "Take care" said Mr. Catton to the Expositor, at one point of the trip through the dissecting room of this giant energy. "Take care, a touch of this point means instant death." The Expositor man's hands went deeply into his pockets. And then, a tiny light glowed, and the giant whom there to touch was instant death, here would warm one's feet or send a healthful tingle over his body.

Mr. Catton had allowed 'juice' travelling at a very great rate—to put the thing as nearly as every-day terms will allow—to pass right through him that, passing more slowly, would kill a regiment of men. Strange; a rod travelling quickly in the school master's hand one remembers from his school-boy days, does not hurt less than one travelling slowly, as in the 'motherly' way."

* * *

Higher or Lower

"Upper or lower?" politely asked the man at the pullman window.

"What's the difference?"

"Well you see the lower is higher than the upper," said the aroused Pullmanite. "And the higher price is for the lower. If you want it lower you will have to go higher. We sell the upper lower than the lower. In other words, the higher the lower. Most people don't like the upper, although it is lower on account of its being higher. When you occupy an upper you have to get up to go to bed and get down when you get up. You can have the lower if you pay higher. The upper is lower than the lower, because it is higher. But if you are willing to go higher it will be lower. Which will you have?"

The Corona Voltmeter

AN instrument for the precision measurement of crest values of high alternating voltages has recently been developed by Dr. J. B. Whitehead as one result of his extensive research on the electric strength of air. He has called it the corona voltmeter, as it depends for its operation on the formation and detection of corona on a round wire when the wire is at a certain voltage.

Accurate measurement of high alternating voltages has hitherto been difficult, for various reasons. For measurement of crest values, the sphere gap,—and with certain limitations in range, the needle gap, have been the accepted standards, and the A.I.E.E. Standardization Rules give tables for the gap lengths to be used with both gaps. It is known, however, that unless great precaution is taken a considerable error may appear due to several causes such as the proximity of neighboring conductors or extraneous electrostatic fields. Under the best conditions, it is claimed that a 2% error is probable, which is large compared with the error in meters for low voltages.

The principle and method of operation of the corona voltmeter have been described by Dr. Whitehead in a paper read before the A.I.E.E. and published in its Transations, *1*. Tests to determine the accuracy of the instrument were made and the results of these tests may be found in a paper by the above author, reference of which is given below, *2*.

The principle of operation is briefly as follows:—If the voltage applied to a wire is raised, a point is reached where the dielectric strength of the air immediately surrounding the wire is exceeded, and a blue glow, known as corona can be seen. For a given diameter of wire, and spacing, the voltage at which corona appears is dependent only on the density of the air, this critical voltage increasing as the diameter of wire becomes larger.

As the voltage at which corona first appears obeys a very definite law, the

1—Trans. A.I.E.E. XXXV. p. 809.
2—Trans. A.I.E.E. XXXIX p. 1057.

only variables being voltage, air density and diameter of wire, it is at once apparent that if means are provided to measure the air density around the wire, and if wires whose diameter is known accurately are used, calibration curves can be drawn establishing the relation between density and voltage. All that is then necessary is to provide a means for detecting the first appearance of corona. The above requirements are provided for in the corona voltmeter in the following way.

An outer tank is provided into which air can be pumped and the air density varied. This tank is provided with an entrance bushing to which the corona wire or rod is attached. Surrounding the rod and concentric with it is a hollow cylinder, which is permanently at ground potential. Means are provided so that rods of various diameters may be used, thus increasing the range of the instrument. The only additional feature is to provide a method of accurately determining the first appearance of corona on the rod. This can be done in several ways (1) visually, i.e., by viewing the rod and noting the first appearance of the blue glow accompanying corona (2) by placing a telephone transmitter adjacent to the rod, and listening for the buzzing sound which always accompanies corona (3) by taking advantage of the fact that when corona appears, the air immediately surrounding the corona rod becomes conducting, due to the fact that the molecules of the air become ionized, and thus are able to conduct a current of electricity.

The first of the above methods is not very satisfactory, because various factors limit the accuracy, such as eye fatigue and presence of other lights. The second method is quite satisfactory if a good telephone transmitter is used, and the rod is smooth and clean. A dirty or scratched rod, or one with variations in the diameter causes local corona, and makes the true corona point difficult to determine.

The third method is perhaps the most accurate of all; the most convenient way of using it is to have two concentric cylinders surrounding the corona rod, insulated from each other, and the inner one of which is perforated with a large number of small holes. These cylinders and the air space between them are placed in series with a source of direct current and a sensitive galvanometer. When corona first appears on the rod, its presence is manifested by a large deflexion in the galvanometer. This is due to the fact that ions are formed by the breaking down of the insulating properties of the air at the corona rod. These ions travel to the surrounding cylinder, and some of them pass through the holes in the inner cylinder, and make the air space between the two cylinders conducting, producing the deflexion in the galvanometer.

An instrument embodying the above principles has been built at the Laboratories of the Commission to Dr. Whitehead's specification, having a range of 50,000-300,000 volts effective. Figure I. shows the complete instrument, which consists of (1) a containing tank, designed to with-

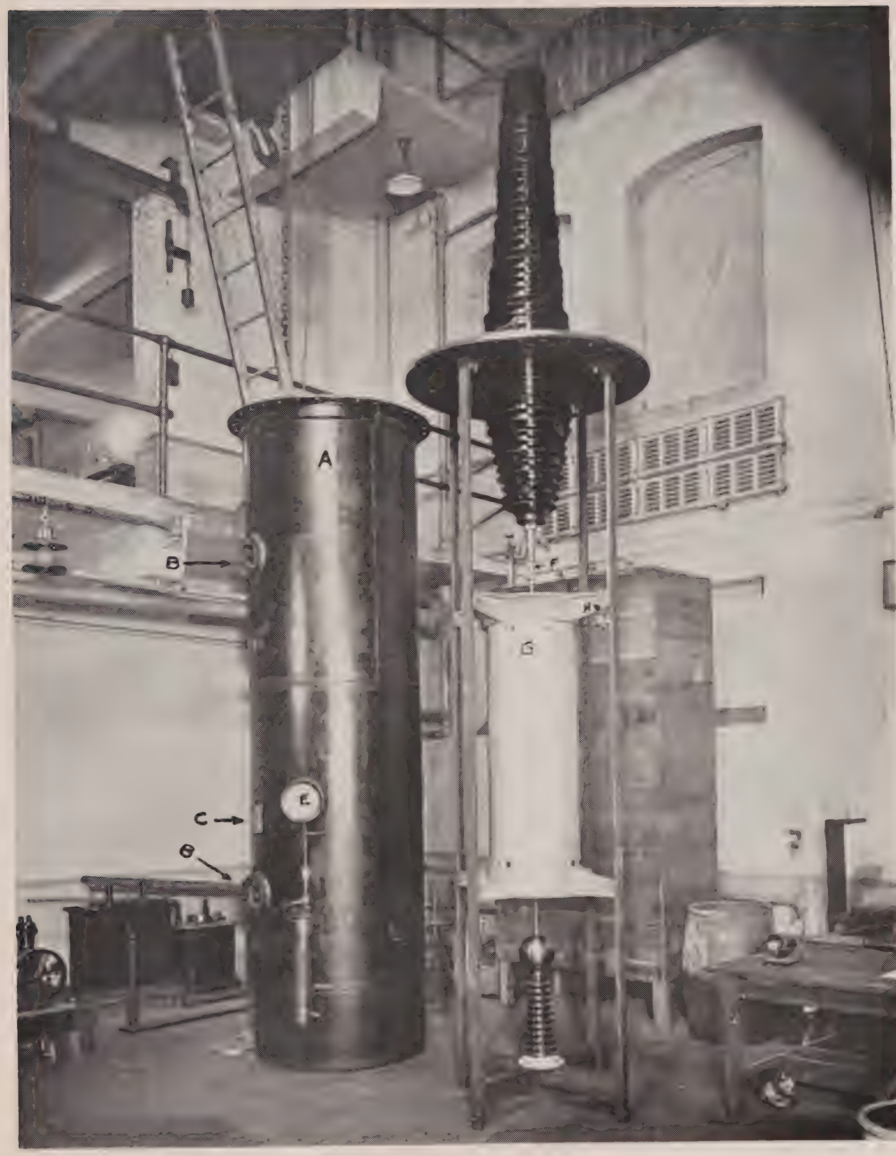


Figure 1

stand a pressure of 75 lbs. per sq. in., provided with two handholes B and a thermometer window, C. Air is pumped into the tank through a calcium chloride dryer D and the air pressure may be measured by an accurate gauge E or by manometer.

As shown in Fig. I, the corona rod F and surrounding cylinders G are suspended from the flat cover of the tank. This allows the rod to be accurately centered within the cylinders.

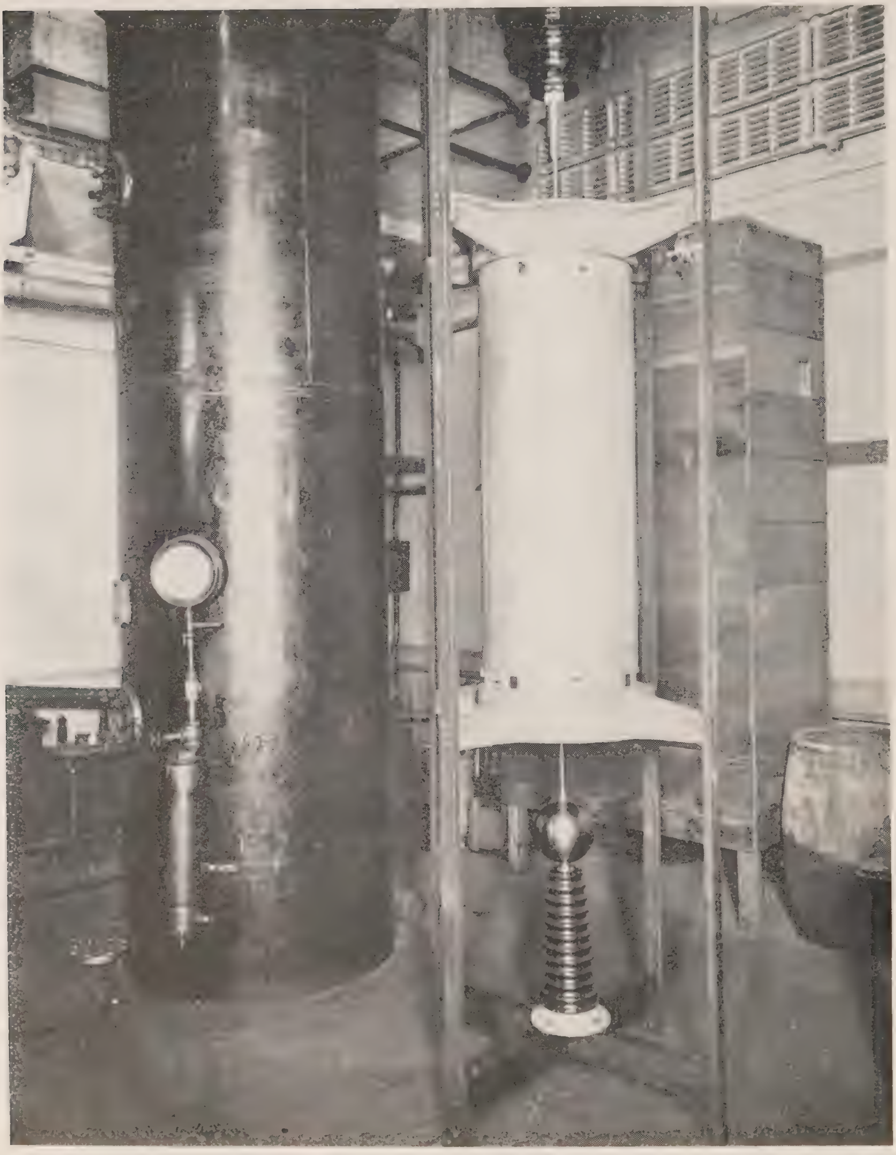


Figure 2

The bushing has a rating of 300,000 volts effective. Figure II. is a larger view of the rod and cylinders.

The corona rod is suspended between the bottom of the bushing and a post insulator, the latter attached to cross pieces of treated wood. The sphere gap at the top of the bushing is to prevent possible corona where the rod is attached to the bushing. The enclosing cylinders are of aluminum. The telephone transmitter H

for detection of corona is shown attached to the suspension rod near the upper spider.

A hole is provided in the cover plate, and the rods are removed through this, after being disengaged from the bushing and sphere by reaching in through the handholes. The rods themselves are made of brass which has been heavily nickel-plated and polished.

The wires to the detecting cylinder and telephone are lead through the top cover plate, and then through lead covered cable, which is grounded. This is necessary due to the strong electrostatic field around the corona rod. Outside the tank, and not shown in Fig. I, the connection from the detecting cylinder is put in series with a high resistance, a high sensitivity galvanometer critically damped and a D.C. circuit, one side of which is connected to ground.

The instrument may be used to measure an unknown voltage, or to determine when a known voltage on any piece of apparatus has been reached. In the first case the procedure is as follows:—A suitable diameter of rod is selected, and the pressure in the tank raised considerably above the point corresponding to the estimated value of voltage which is to be determined. This pressure can be found from the curve supplied with the instrument, which curve is calculated, and is determined solely by the dimensions of the rod and surrounding cylinder. The voltage to be determined is then applied, and the pressure lowered very gradually until corona is detected, when the pressure is read from the gage or manometer. The voltage corresponding is then found from the curve for the diameter of rod used.

If it is desired to apply a known voltage to a piece of apparatus, as in a high potential test, the air pressure corresponding to the required voltage is found from the curve or table. The tank is then pumped up to this pressure, voltage is raised until corona is detected. The voltage is held steady until the test is completed.

The voltage at which corona first appears is very sharply defined, and if a step-by-step regulator is used on the low tension side of the testing transformer, it is possible to determine the corona point more closely than the regulator can be set. This is as great precision as is required for most tests. An accuracy of one half of one per cent. is claimed for the voltmeter, but no tests have been made on the instrument in the Laboratories to check this.

Dr. Whitehead has listed, *3,* the following apparent advantages of the corona voltmeter:—

"(a) Freedom from disturbance by proximity of neighboring conductors or extraneous electrostatic fields.

"(b) A 2% inaccuracy is the minimum claimed for the sphere gap. With careful manipulation and good circuit conditions it is certain that a corresponding figure of better than 0.5% is possible with the corona voltmeter.

"(c) No manipulation of high voltage circuit. Each change of setting of the sphere gap requires altering the distance between the discharge

3—Trans. A.I.E.E. Vol. XXXIX. p. 1108.

spheres. The setting of the corona voltmeter for different voltages requires the change of air pressure only.

"(d) No discharge of high voltage circuit and no series resistance necessary. The reading of the corona voltmeter is continuous and stationary and draws no current from the high voltage circuit.

"(e) Measurement of an unknown voltage. This cannot be done with the sphere gap except through repeat-of opening of circuit and successive approximation.

"(f) All parts of the corona voltmeter are grounded except the leading-in wire of the high tension terminal. All dimensions remain fixed. All auxiliary circuits are at low values of continuous voltage.

"(g) Permanence. The surface of a corona-forming rod remains unaffected under the continuous application of initial corona over long periods.

The instrument in the Laboratories has been used to measure the flash over voltage of low tension line insulators for Queenston generating station, at the time when experiments were being made to determine the shape of insulator to give the highest flashover for a given distance between faces. The results indicated the advantage of having an instrument of this kind for tests such as the one cited, and justified the claims made by Dr. Whitehead in many respects. It appears to be certain that a step in advance has been made in the accurate measurement of the crest value of high alternating voltages, and that this instrument will be the means of permitting further investigation where these were handicapped in the past by the fact that accurate measurement of voltage was extremely difficult, and often impossible.

* * *

An Unusual Power Plant

A reader has given us information concerning a power plant used by a manufacturer during a period when his regular power supply had failed.

The Company in question had a large motor truck placed on the street opposite one of the windows of the factory. One back wheel of the truck was jacked up and with this as a driving pulley, a belt was passed in through the open window to a pulley on the main shaft of the plant. By means of power supplied by the truck motor the plant was kept running until electric service was restored.

The illustration shows the position in which the truck was placed and the rough guard erected for general protection. The tarpaulin was placed over the installation for the purpose of keeping the belt dry.

Conditions like this are unnecessary in towns where there is Hydro power.

* * *

HYDRO NEWS ITEMS

Central Ontario System

The Picton Public Utilities Commission is planning improvements to the street lighting in the business district.

* * *

The Police Trustees of Warkworth are submitting an enabling by-law at an early date. Negotiations are under way with owner of the local electric plant. It is estimated that from 20 to 35 h.p. will be required in the village.

* * *

Improvements to the coal handling apparatus at the Peterboro Gas Works are under consideration.

* * *

The new plant at Raney's Falls went into operation on August 22nd.

* * *

Estimates are being prepared for improved street lighting on King St. in Cobourg.

* * *

RURAL

A meeting was held at Campbellford and large canvassing committees are working in the district to obtain sufficient contracts to warrant the construction of rural lines in Seymour Township.

* * *

Niagara System

The Municipality of Dunnville is at the present time constructing a new waterworks pumping station, and installing a 150 h.p. direct connected fire pump, a pump for domestic service equipped with a 60 h.p. motor and an air compressor equipped with a 30 h.p. motor. The sewage disposal plant is operated on the ejector principle and the compressed air is used for that purpose, being piped from the Water Pumping Station to the sewage disposal plant, which is some distance away.

* * *

The Hagersville Quarries Limited have installed an electrically operated shovel in their rock quarry. This shovel has a seven-eighths yard bucket, and requires 100 h.p. to operate. It has been found that the electrically operated shovel is much more satisfactory and more economical to operate than the steam shovel which was formerly used.

* * *

An outdoor sub-station will shortly be installed close to the Commission's Dundas High Tension Station to supply power to the Dundas Rural Power District. The station will be equipped with 1-300 kw. three-phase, outdoor type transformer, with a secondary voltage of 4,000 volts. This system is at the present time being supplied

from the Dundas Municipal Sub-station at 2,200 volts. It is considered advisable to change the distribution system in the Rural District to 4,000 volts, and the Dundas Municipal sub-station will be relieved of this rapidly growing load.

* * *

An outdoor type sub-station will shortly be installed at Chippawa to take care of power supply to the Village of Chippawa and the Chippawa Rural District. A rural line was recently constructed from Chippawa to the Hamlet of Stevensville. Underground cable has been used in this district.

* * *

Arrangements are being made to increase the capacity of the Commission's Sub-station at Milverton from 3-75 kv-a. transformers to 3-150 kv-a. transformers.

* * *

It is expected that within the next few weeks that power will be supplied to the Petrolia Municipal water pumping plant, which is located on Lake Huron, at Perch. A 26,000 volt double circuit line is being built to tap the Sarnia line, and a sub-station of 225 kw. capacity is being installed at the pumping station.

* * *

The Municipality of Port Dover is installing a Waterworks System. The pumps will require 20 h.p. An additional power customer was recently obtained in the Municipality, and the number of lighting consumers has shown a remarkable growth within the last six months.

* * *

A contract has recently been signed with the International Nickel Company of Port Colborne for a supply of 1,000 h.p. to be used in their electrolytic process of refining nickel. The Company has been carrying on the electrolytic process at Bayone, N.J. It is expected that this Company's load will very soon increase to a very considerable amount.

* * *

All of the machines recently injured in the accident at the Ontario Power

Window Display, Toronto Hydro-Electric System

Company's plant are again in service, with the exception of two which were quite badly damaged.

* * *

The installation of additional machines at the Chippawa plant is being rushed forward as rapidly as possible. It is expected that a sufficient number will be available to take care of the coming winter load. On account of the coal shortage and the subsequent use of air heaters it is expected that the demand will be exceptionally heavy.

* * *

The construction work in connection with the Beamsville Rural Power District is proceeding very rapidly, and it is expected that the greater part of this system will be constructed before December 1st. Underground cable is being used on top of the escarpment in this district. In general, the use of underground cable in rural power districts has been, up to the present time, exceedingly satisfactory. The underground cable installed in Saltfleet Township has been remarkably free from interruptions during the present year.

Ottawa System

The Ottawa rural district continues to develop. An addition of six miles of line is being built to serve a number of farmers on the Ottawa-Prescott Highway.

Rideau System

A number of large feldspar mining propositions are developing in the vicinity of Perth. Feldspar is used largely in porcelain enamel, but the heavy American tariff on powdered feldspar bars the way to the market in the U.S.A. It is expected, however, that the Canadian development of the ceramic industry will provide a large market in this country. The mines should become heavy power users in the future.

* * *

One of the largest woolen mills in Carleton Place is considering the use of off-peak power at night for their dyeing and boiling process. They have requested rates on 500 h.p. to be used between 11 P.M. and 6 A.M.

* * *

The Grenville Crushed Stone Company, near Merrickville, has increased the capacity of its plant, and is now taking a load of over 600 h.p. from the Commission.

* * *

The Villages of Lanark and Kemptville have had a reduction in the second domestic rate from four cents to two cents, and are planning an active campaign for the sale of ranges and other appliances.

Severn System

There is a prospect for a very large increase in load on account of summer resort business on both the Severn and Wasdell Systems. Already the Town of Beaverton serves 100 customers outside the limits of the Municipality, all of which are practically in the summer resort class along the shores of Lake Simcoe. A large number of contracts have been received at Shanty Bay in the vicinity of Barrie, which is also a summer resort district, and it is expected that these customers will probably be served with Hydro power by the beginning of the next season. Possibly

100 contracts have been secured at Wasaga, near Collingwood, and Stayner, and if it is possible for a few more contracts to be secured there is every assurance that Hydro service will also be available for this summer resort district next season.

* * *

A new sub-station has been constructed in Midland for the purpose of serving the Grand Trunk Pacific Elevator at Tiffin. This load is very similar to the C.P.R. terminal elevator at Port McNicol, and the customer will use in the neighborhood of 800 h.p. The securing of this load assures the municipality of Midland of a greatly increased demand in future, which is bound to affect the cost of power, and it is very gratifying to users of Hydro power, when it is realized that such a proportion of the terminal elevators both at the head of the Lakes and at the receiving end on Georgian Bay are being served with Hydro power.

St. Lawrence System

Contracts have been received for service at rural rates from residents of the Police Village of South Lancaster, in the Martintown Rural District, and it is expected that an extension from Lancaster Village will be made this year to supply these consumers.

* * *

Additional contracts for service have been received from rural residents on the Martintown-Lancaster Line in the Martintown Rural District.

Estimates on the cost of power and a distribution system have been prepared for the Village of Cardinal, and will shortly be forwarded to the Municipality.

* * *

The construction work on the St. Lawrence System which has been in progress during the summer will be completed shortly, and the transmission voltage will be changed from 26,000 to 44,000 volts about Oct. 1st.

* * *

The Eugene Phillips Company contemplates starting operating their new Brockville plant in October, shortly after the changes referred to above are completed.

Wasdell System

The new distribution system in the Municipality of Uxbridge which has been in course of construction during the last three or four months is now practically completed, and it is expected that power will be delivered to the municipality at an early date from the new Greenbank sub-station, which receives energy from an extension of the Wasdell transmission line extended south from Cannington.

* * *

The new distribution system in the municipality of Port Perry is now practically completed and service will be given to this municipality from the Greenbank sub-station at the same time power is delivered to Uxbridge. Power is delivered to the Greenbank sub-station at 22,000 volts, and the two municipalities are served directly from a 4,000 volt line out of the sub-station, which will also give service to a large number of farm customers in the district.

* * *

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CONTENTS

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OCTOBER, 1922

History of the Hydro-Electric Power Commission

In this issue we give the first of a series of articles outlining the development and work of the Hydro-Electric Power Commission of Ontario. The object of these articles will be to place before the reader briefly the various arguments and events that lead up to its formation and the work carried on up to the present time.

"Public Ownership of Public Services" has been taken from Mr. E. B. Biggar's book entiled "Hydro Electric Development in Ontario." Public Ownership is shown to be a very ancient thing, while Private Ownership of Public Services is comparatively modern, and has not been conductive to "the greatest good to the greatest number." It does not deal with facts directly affecting the Hydro-Electric Power Commission, yet it shows that the principal on which the Commission is constructed is one that has long existed, and has been tried and found not wanting.

* * *

Electric Heating

The recent strike of miners in the United States coal fields with the resultant depleted supplies of coal have put the idea of electric heating in the minds of people much more forcibly than ever before. It is timely, therefore, that a proper warning be given that electricity should not be used for heating of houses, except as an auxiliary.

Where heat is required intermittently as in cooking and other domestic uses, or in a room during cool evenings of the fall or spring, where only

a little heat is required, electricity can be used to advantage and economically. If, however, one were to attempt to use only electricity for heating a house during the cold winter months, even with the lowest rates in force in any of the Hydro Municipalities, it would be extremely expensive.

Utility officials should therefore make a careful study of the article given herein on the heating of houses. They will then be prepared to advise any of their consumers as to the extent to which electricity may be used for heating purposes and thereby prevent them from rushing into something that with proper advice they would not think of doing. They should also advise against using electric heaters during winter evenings as a means of permitting lower fires. Such practices are inadvisable, in that the distribution systems are most heavily loaded at that time, so that the general use of heaters may cause the voltage to become too low for satisfactory lighting. To carry such load at such times will necessitate a material increase in the investment for the distributing system and also in the load taken by the Municipality. The result would be that the rates for service would be increased, which would in turn increase the consumer's bills.

History of the Hydro-Electric Power Commission

NO. 1.

Public Ownership of Public Services—General Principles

By E. B. BIGGAR

FOR several generations the main highways, the railways, and to a great extent, the canals of Great Britain, the United States and Canada have been under the control of private individuals and corporations. In extensive regions of these countries the ownership and administration of the chief channels of communication by private companies has been so long continued and complete that it has been accepted as the natural order of things, just as the motion of the earth or the moon is accepted as following from the laws of the universe.

Is this authority of a private person over the means of transport and other public services such as power and light a natural and ancient right or is it a modern tresspass? The question can be answered with absolute certainty. The necessity of means of travel and the common right to those means is set forth clearly at the very

beginning of the history of our race. To Adam and his descendants the command was given: "Replenish the earth and subdue it." The public right to the means of traffic is not merely implied but is imperatively required by this proclamation of the Creator. How could the world be colonized and the waste places replenished without a common right to move from place to place, and how could this migration continue without recognized rights of way? If it should be shown that no bar to migration existed in primitive times because there was then no private ownership of land, this would not in any way lessen the public right to the means of travel. It would, in fact, concede the public right to hold land and roads, for the one right would include the other.

It is remarkable that after the flood, when, by reason of the incurable wickedness of the ante-diluvian peoples, the slate was wiped clean and the race was given a new start under changed conditions, the same injunction to "replenish the earth and subdue it" was given, and in precisely the same terms. Thus was emphasis laid upon the first injunction.

The natural instincts of every ancient people must have urged them to fulfil this divine injunction, for if it had not been so we should have had no traces of those mysterious movements of nations of the remote past that have so puzzled students of ethnography. We know, moreover, that the Babylonians, Egyptians, Medo-Persians and other nations, not to speak of the Romans, treated as a public right the primitive highways along which the King's proclamations and armies were sent.

The migration of the Israelites from Egypt to Palestine furnishes a striking specific sanction to the theory of the common right to the highway. As they approached the promised land the Israelites had to pass through territory occupied by the Amorites, and the sacred history states that Moses was required to ask from the Amorite King, Sihon, a right-of-way through his territory. We must infer that this request would not have been made by divine instruction, if it had been unjust, or contrary to common usage or natural right. Indeed the only ground of refusal likely to be taken was on the question of injury to property in passing, but Moses anticipated this by instructing his embassy to assure King Sihon that no injury would be done to property and that the Israelites would confine themselves to the high road. "We will go by the King's highway" is the expression as translated, and it is significant that the phrase "King's highway" occurs at this ancient date in such a connection as not merely to imply a public right acknowledged among the Amorites in their own government, but as clearly implies the admission of this right to the subjects of another ruler, the only condition being that of peaceful passage. Such a condition as private ownership of the highway could not have existed, or Moses would have recognized this by offering compensation to the owners which he did not do. So evident was this refusal of thoroughfare held to be a denial of a

natural right that the advance was made by force of arms, and this explains the annexation of Sihon's territory to the promised land.

As the Israelites continued their journey the same question arose in the case of Og, the King of Basan, with the same result. The inherent public right to the use of the road was assumed from the beginning to the end of these episodes.

Thus the fundamental conditions under which the world was to be peopled and its resources made to subserve the uses of mankind required that the means of migration and the channels of traffic should be a public right, publicly exercised. The logic of history is against the theory that the people's highways should be regarded as private property. That this function should be made the subject of private profit is therefore not founded on an ancient and natural right, but on a modern perversion.

All nations, from those of remote antiquity down to that modern hermit people, the Thibetans, have recognized the need of a common right-of-way, but if this public right of communication had not been thus based on the instincts of the human race, the necessities of modern civilization would have called for its creation, owing to the advent of the railway and other mechanical means of transport. There is no need now to prove that the railway is the successor, in modern life, of the highway, for the service of the railway carries its own proof in the function it fulfils. The advent of steam and electric power and the development of the modern factory system involving the division of labor have made the railway at once a universal servant and a universal master. Railway freight rates, passenger rates and express rates are not commodities bought in a market by the citizen but taxes paid for a public service. These rates are none the less public taxes, because the railway may be operated by a private corporation, for that corporation can only act as a creature of the government, through the charter by which the government delegates its authority. Unlike many forms of taxation, the taxes known as railway rates are an inescapable burden, falling upon poor and rich, for there is not a single article that is bought or sold that does not owe to the railway or highway service some element of its cost or production. Proofs of this fact have been fully set out in another work, in which,* after various illustrations, the true relation of the railways to the people is stated in the form of five main propositions substantially as follows:

First—The railways of a country are the main highways of a country.

Second—There is no source of railway revenue other than the rates imposed upon the people for the carrying of their persons and their goods.

Third—This revenue is raised, not from any hidden fountain of wealth within the railway itself, but from the earnings of the people whose labor and money furnish the traffic.

Fourth—By the division of labor in modern civilized life, everyone who

* "The Canadian Railway Problem." Macmillan & Co., Toronto.

earns or spends money contributes directly or indirectly to the cost of transportation, and this cost enters into every article used by every citizen.

Fifth—A nation's means of communication is a function of sovereignty, and since all the people contribute to their cost, railway rates are a national tax, and when traced to their ultimate effects are found to be the largest element of all forms of taxation.

Now it follows logically from the last proposition that when a state delegates this power of taxation to a private company and that company exercises this sovereign power for its own profit in operation, those profits become a tax upon a tax. With only this difference, that the one taxing power is held by a joint stock company and the other was usually held by an individual, the system is precisely that which was permitted in the declining years of the Roman empire, when the customs and other revenues were raised through authority delegated to men known as "publicani," who made their wealth by the surplus they were allowed to take from the people over and above the tribute required by the government. The publican merely anticipated the policy of the modern transportation franchise holder of levying in rates "all that the traffic would bear."

The fact that electricity, coupled with hydraulic power has become essential in transportation. lighting and other common functions, brings this new power under the same rule of public right.

The principal of self-government in the transportation service and in those services such as public lighting, the supply of power, water and other requirements that govern modern community, is vital, not only because without the satisfaction of these needs such community life could not exist, but because the cost of maintaining them has become the most searching and inexorable of all forms of taxation. The inquisitions of the income tax officer may be circumvented, the customs duties may be evaded, the inland revenue collector may be avoided, but the direct and indirect levies of the railway, highway, steamship and other public services fall alike on youth and age, wealth and poverty, on the citizen of the metropolis and the hermit settler in the remotest woods. The tax is taken in a thousand forms, most of them without the cognizance of the tax payer, and never once need he be confronted by a customs officer or income tax assessor, but through the self-inquisition of his own daily needs. Indeed, he may never have personally paid a freight bill or bought a railway ticket.

It is a fundamental principal of representative government that the people who pay the taxes shall control the disposition of those taxes. "No taxation without representation," and "millions for defense—not one cent for tribute" were the demands that had their issue in the American revolution; but, while maintained in form, the principle was abandoned in practice when the modern highways were given over to private corporations to be operated for private profit.

The "farming out" systems on the highways of England began in 1663, when the counties of Hereford, Cambridge and Huntington were permitted by act of parliament to levy tolls for the maintenance of the trunk roads, and the turnpike trusts, thus permitted, developed into such powerful corporations that when the era of steam railways began these companies were able to extend to the railway systems the monopolies they had held over the turnpikes. That the turnpike trusts were organized primarily for profit to the shareholders may be inferred from the estimate made by Adam Smith, author of the "Wealth of Nations," that the tolls levied at the gates of the turnpike trusts were more than double the sums needed to maintain the roads in repair. The methods by which their successors, the railway corporations, not content with the profits of railway operation, exploited the great natural resources of the country such as coal and other mineral lands, forests and agricultural lands to their own enrichment, gives ground for the charge that the surrender into private hands, for private profit, of that which is by its nature a function of the sovereign state has been the source of grave corruption of public life in the past. That which has been said of the power of song might be paraphrased in the realm of politics: "Let me own a country's railways and I care not who makes its laws."

Yet the aim of public law is righteousness and these ancient rights are being revindicated. The postal service, which in its nature is similar to that of the railway and express, was once under private control in Europe and Asia, but is now under state operation in every country in the world. The post office, was always expensive and inefficient under private ownership, and it never became cheap and universally serviceable till it was brought under state control and operation. The history of the postal service is being repeated throughout the world in the railway, and other services which by their nature govern community life. Starting with the single Kingdom of Belgium—which at the very outset of its railway building, recognized the transport service as a matter of public concern,—the theory of public ownership has been applied in practice in one country after another, under all forms of government, until at the outbreak of the European War, Great Britain, the United States and Canada were the only countries of importance where the majority of the railways were under private ownership. The events of the war demonstrated in hard practice, what ought to have been evident in simple logic, that the railway service is a unity in its nature performing the one function to the whole nation and to every class within it. That the duplication of lines to the same centres was a waste of material, labor and land was equally demonstrated; and the whole theory of "competition" under private ownership was shattered beyond recovery on the field of war.

The deduction from this history is that the public control of public functions is not a matter of expediency but a matter of right and duty, and the obligations to public control will not be affected in the least if it could be shown that private ownership is more

efficient than public. The failure or weakness of one administration is not a reason for abandoning the principal of self-government, but rather for the reform of the civil service or methods of operation. If anything goes wrong in our post office we do not dream of handing back to three or four private companies the control of our means of intelligence, but we demand new men and better methods.

Advocates of the private ownership of a public function imagine that the people's rights are to be secured through competition among private corporations. This is a fallacy that obtained wide acceptance in the first railway era when the railway companies, by duplicating and triplicating the lines to the chief centres of traffic were seeking a share of those revenues drawn in every case from the community at large. Rates often were lowered while the companies were extending their reach, but as soon as they attained their aims, then their wider object of maintaining the tolls was sought in amalgamating the local systems with which they had connections.

George Stephenson, whose grasp of railway economics, was equal to his knowledge of railway engineering problems, thus stated the principle: "Where combination is possible competition is impossible."

As before shown, the railway serves the same purpose to the entire community and to each individual in the community. It is therefore a unity in itself, and unity cannot be maintained by disjunction or competition.

That competition, as exemplified in the multiplication of railways between the same cities in Canada, has lessened the cost of transportation to the Canadian people is an illusion that has now been dispelled. The second and third lines between Toronto and Montreal for example, have cost the country over $60,000,000, besides the annual maintenance and operating cost of $3,500,000 to $5,000,000, and the waste of land, labor, etc., on the three rights-of-way. Instead of bringing a reduction of rates, which was the proposed object, the triplication of lines, by a tacit agreement between the "competitors," has actually been followed by increases. Meantime an area of land in Ontario as big as several European states still remains a desert because of the lack of the 850 miles of track devoted to this illusory "competition."

From the principles set forth it should not be inferred that those who invested money in public service companies did anything more reprehensible than those who bought shares in factories or mines. They found the private control of state services, or community rights, in existence and, therefore, took it to be right. The primary wrong is, therefore, not with the investors, but with the system which in the past two centuries has tended to give semblance of right to the claim that the public service itself is a private perogative. If a delegated privilege of collecting taxes can be construed into a claim for good-will, or an inheritance in favor of the tax collectors, then government by the people and for the people is only the shadow of a lost power.

Lack of Knowledge Cause of Most Power Company Complaints

Investigation Conducted by San Joaquin Light and Power Corporation Show Ignorance of Electricity is the Cause of the Majority of Consumer Complaints Received by that Company

By C. B. MERRICK

There are always those in any field who desire to impress the laymen with the difficulties of technical knowledge. Very few plumbers will acknowledge that the householder has any chances with a clogged drain or a leaky faucet, and it is the exceptional carpenter who has aught but scorn for the amateur handy man. The electrician is not exempt from this failing, and much of the present inability on the part of the public to change a fuse or connect up an extension cord is due to the impression of the difficulty of the task gained from the electrical men with whom they have come in contact.

A wholesome respect for things electrical is a healthy state of mind. It is just as well that the jack-of-all-trades with which each family is provided should realize that home experiments in wiring are apt to cause him the loss of his insurance in case of fire. But there is no excuse for the common lack of knowledge in regard to fuses and several other simple departments of repair work. Power companies would be saved much unnecessary expense if they were freed from the many calls for service which are entirely unnecessary. In some cases where lines extend for twenty miles out into the country from the nearest office, the expense item for the change of a fuse is quite startling.

The manufacturers are awakening to the advantages of simplifying apparatus so that the layman may make these simple replacements. It is time that elementary lessons in fuse changing and similar operations became part of every wiring job, and particularly of every range installation. It is surprising how much the average housewife is capable of learning if she is told.

ALL complaints which consumers make to their power companies can be divided into three classes, the first and second of which are real complaints and imaginary complaints. When a consumer complains he usually has a firm conviction that something is wrong, and the condition must be corrected or this conviction changed before the consumer is satisfied. A few consumers belong to the third class and enter complaints in order to withhold payment of their bills, but this happens only with cer-

tain consumers who become known to the collection department. However, these complaints require just as careful attention as the others.

The Inman Investigating Committee, appointed by the State Senate to investigate the decisions of, and complaints against, the California State Railroad Commission, recently toured the State and held public hearings. They reported that "The primary reason for complaints against the power companies is due to misunderstandings between the public and the companies."

The San Joaquin Light and Power Corporation recently conducted investigations calculated to determine what proportion of the total complaints coming into their complaint department were legitimate, and which were not, and from what class of consumer they originated. Also to show how many corresponding investigations were initiated by special request of the consumer's department or other employees of the company. Tables showing this analysis are given later in this paper. It was found that where the complaint was real and some error had been made in the meter reading or in the calculation of the bill, the settlement was easily handled. This applied also to the few meters found out of adjustment and registering fast.

But, on the other hand, where the complaint is imaginary, and some definite cause, such as seasonal variation or exceptionally cold weather, with resultant use of electric heaters, has caused the increased bill, special diplomacy was found to be a first requisite for persuading the consumer that the company is fair-dealing and its employees anxious to satisfy the consumer as well as themselves that everything is correct. In these cases the psychological effect is an important factor. The employee is the company to the average consumer, and the employee who is overbearing or who shrugs his shoulders and says: "That is not my job," or just "You have no kick coming," is creating unfavorable rather than favorable "public opinion."

An article recently appearing in the Pacific Service Magazine gives some valuable advice to employees who handle complaints. A quotation from this article states:

"As a way to bring about this elimination of many complaints, I would suggest that you thoroughly familiarize yourself with that branch of the work in which you are occupied, then endeavor to absorb as much as possible of the other branches.

"When confronted with a complaint, whether on the job, in the lodge room, at a friends' home, or at your church, endeavor to explain to the complaint's satisfaction. Even if it is something with which you are not thoroughly familiar, do not let it go unchallenged or unattended to. Refer it to some one who does know and who can give the satisfactory answer."

Results have shown that the investigator of a complaint should be very careful about his method of procedure. It is important that he should get all available information, such as previous readings, average consumption, and a check of the bill calculation, before going on the job.

Suggestions to Employees

The following suggestions directed to the man who handled the consumer's complaint have been found by the San Joaquin Light and Power Corporation to be very effective.

The consumer must be carefully approached as his confidence in your later statements is affected by his first impressions. The proper approach can often be determined by the style of the complaint, as the wording usually indicates whether or not the consumer is acquainted with electrical terms. Later examples will bear out this statement.

Ask for the consumer by name. Introduce yourself by name, and, if possible, present your card. Continue to call the consumer by name, and he will return the favor, referring to the card if he forgets.

The characteristics of the consumer are important. If he is a busy business man, then waste no time. If he is an engineer, interested in the details of your investigation, give him the details he desires. If he is inclined to talk, listen patiently while continuing the investigation. He will probably quote cases of ten years ago when "Such and So Electric Co.," of Arizona or New York, tried to cheat him, but he caught on and refused to pay the bill. But let the consumer do the talking, until your check of the installation is complete. Be careful not to voice any conclusions before this check is completed. The only positive statement made to the consumer prior to that should be that the company will correct any error. To accomplish the desired result, the investigator should have full authority to report to the consumer and make any adjustment found necessary.

Each case should be treated as an individual one. Every consumer likes to feel that he is entitled to special service and any interest shown in his personal affairs is usually appreciated. Guess what he is interested in and direct the conversation into those channels, at first, to gain the confidence or good feeling of the consumer. More imaginary complaints are settled after this confidence is established by discussing the consumer's new grocery store, and admiring the antics of the five-year-old son, than by talking only gear ratios, load factors, or disc constants.

Ask leading questions that will tend to bring out the actual facts or the consumer will probably not tell you of some condition that existed, and which had been entirely forgotten until you asked the question that tied in the condition with his complaint. A query about blown fuses will often reveal a defective iron cord that has been repaired, or other similar trouble.

The findings of the investigation, whether or not there is an error, should always be given the consumer in order to permanently satisfy him.

Results of Investigation

A detailed analysis of nearly five hundred investigations made by the San Joaquin Light and Power Corporation reveals the following proportions between "consumer's complaints" and investigations initiated within the company.

	No.	%
"Consumer's Complaints"	269	66
Investigations by company	214	44
Total	483	100

The above "consumer's complaints" were the ones that could not be settled by casual discussion in the office and required one or more visits to the premises in order to clear. Often they required many visits. On the other hand it does not include the miscellaneous activities instigated by the company, such as check readings, or analyses of accounts for proper rate, resulting in advising the consumer of a better rate for his service. It covers the cases, originating largely in the consumer's department, where an abnormal change in consumption has occurred, this change being either an increase or a decrease. In this way many "complaints" are forestalled by previous action on the part of the company, a service which is appreciated by the consumers.

This analysis also shows that of the 180 complaints of high bills, 163 were made by lighting consumers and 17 by power consumers. Of these 180 high-bill complaints, 84% or 151 were reported back as having "no error." This indicates the importance of the proper handling of the complaint, as in most of the cases no error was found. It also indicates that the largest proportion of complaints is due to misunderstanding, or to some condition with which the consumer is unfamiliar, such as the change in artificial lighting hours between winter and summer. This is readily verified by a study of the increase in number of high-bill complaints as the winter season approaches.

The analysis is shown in tabulated form, below—

CONSUMER COMPLAINED							CONDITION FOUND		
Nature	Light		Power		Total		Nature	Total	
	No.	%	No.	%	No.	%		No.	%
(1) High Bill	163	34	17	3	180	37	No error	151	31
							Meter misread	22	5
							Meter defective	3	1
							Accidental grounds	4	1
(2) Miscellaneous	63	13	26	6	89	19	No error	46	10
							"Creep" due to accidental grounds	5	1
							Meter creeps	26	5
							Miscellaneous	12	2
INVESTIGATIONS REQUESTED BY EMPLOYEES									
(3) Meter Defective	96	19	42	9	138	28	No error	62	13
							Meter defective	61	13
							Meter overloaded	9	2
							Not in use	4	1
							Misread	2	....
(4) Inconsistent Readings	13	3	4	1	17	4	No error	7	1
							Misread	10	2
(5) Check Installed Load	—	—	59	12	59	12	Information only	59	12
Totals	335	69	148	31	483	100		483	100

The heading, Inconsistent Readings, covers cases which could not be cleared by check readings, which have been previously made in each of the 17 cases listed.

The net result of the foregoing discussion and analysis is that electricity is considered a marvellous and unfathomable mystery by most consumers, even well educated persons using strange terms to express themselves in their complaints. Fact is stranger than fiction, as is shown by a few examples of letters received by the complaint department:

1—"The power is not strong enough to run Electric Iron except spasmodically, and the Spirit in the meter that usually revolved in lively manner sometimes crawls and again won't move at all."

(A bad fuse was responsible.)

2—"For the last five days my meter goes galloping at a fearful rate, making such a noise that one can hear it in the next room from which it is placed. It at least requires oiling, or some attention paid to its mechanism."

(This meter was 300% overloaded.)

3—"Please chekt over my electric light bill I use only one glob in all my please and only 2 ours per day there must be some mistek."

4—"I am perfectly willing to pay for what I get so there is only one of three things the meter is on the blink or the reader has made a mistake or the co needs the money or possibly someone uses the juice in my Absence. Whatever the cause I think I am paying $1.53 for something I did not get."

It is apparent from the above that the public must be educated in electrical matters. There is much merit in the "Letter to the Editor," by J. W. Melhorn, published recently in the Journal of Electricity and Western Industry, suggesting that this education should start with the matter of replacing blown fuses. This would be one long step in the right direction resulting in benefits to the industry, for it would:—

1—Take the mystery out of the word "electrical."

2—Teach the public to distinguish between quality installations, and slipshod, unsafe jobs.

3—Save the power company and ultimately the public, the cost of this replacement service.

This education is well within the limits of possibility, for a public that can master the mechanism of an automobile and the intracacies of wireless telephone, can surely grasp the details of testing for and replacing a blown fuse.

—Journal of Electricity and Western Industry, September, 1922.

Ranney's Falls Development

A GENERAL description of the equipment planned for the Commission's new generating station at Ranney's Falls, on the Central Ontario System, was published in the July, 1920, BULLETIN.

This station was completed this Summer. The first of the two units went into operation on August 22nd, and the second on September 2nd. Since September 2nd the plant has been carrying load continuously with the exception of short interruptions for minor adjustments.

At the present time the output of the plant is delivered to the system by means of a loop of Line R (the 44,000 volt line connecting Healey Falls and Trenton). It is the intention to bring in a loop from Line G (the 44,000 volt line connecting Dam 11 Plant and Belleville), and also to deliver power to the Commission's pulp mill, adjacent to Ranney's Falls, at 6,600 volts, which is the generator voltage.

The completion of this plant brings the total generator rating of the Central Ontario System up to 33,675 k.v.a., and will provide reserve capacity so that other plants may be shut down for adjustment and repairs.

It is expected that the normal growth of load on the Central Ontario System will absorb the full output of the new plant by the end of 1923.

Preparations are under way for developments at Dams 8 and 9, to provide for the future requirements of the system.

The table below shows the Central Ontario System monthly peaks in horse power since 1916:—

	1917	1918	1919	1920	1921	1922
January	20,800	23,000	21,400	27,500	28,320	24,320
February	21,700	21,600	17,400	24,600	27,920	25,620
March	21,500	22,600	17,400	25,200	27,650	27,000
April	18,600	24,200	18,000	23,000	24,035	26,650
May	19,320	23,800	18,100	23,800	23,740	26,510
June	17,500	24,600	18,800	24,000	23,770	26,700
July	17,400	23,500	20,100	22,200	21,940	26,900
August	17,210	23,500	21,800	23,000	22,090	27,800
September	18,200	25,100	21,900	22,900	23,370	31,600
October	20,200	25,800	24,300	23,000	26,110	....
November	25,800	23,300	25,000	26,200	25,670	....
December	26,100	23,500	26,000	27,320	25,430	....

The Heating of Houses

Coal and Electricity Compared

By A. S. L. BARNES,
Assistant Engineer, H. E. P. C. of Ontario

DURING the past few years and, perhaps, more particularly since the fuel problem has become acute in Canada, an idea appears to have been gaining ground that the immense water-powers of this great country (which by many people are vaguely considered as being illimitable) will amply suffice to meet all heating requirements; and that, in the provinces of Ontario and Quebec, especially, where water-powers are so abundant, the fact that little or no coal is ever likely to be found is of no consequence.

Electric heating has so many advantages over other methods that probably "the wish is father to the thought" that it may some day replace coal, gas, etc.

The fuel problem to-day is so serious that technical men all over the country are looking at it from every aspect; the more efficient use of coal in furnaces, the manufacture of gas from coal, peat, etc., the briquetting of lignite coal and peat, and the possibilities of electric heating have all been receiving careful attention for some time.

Unfortunately, some engineers and a few other persons, who ought to know better, have been giving out hints that sooner or later electricity would come to the rescue and solve the heating problem completely. Unquestionably, in some of the more temperate regions of the world such comparatively small amount of heating as is required may be supplied through the medium of electricity, but the situation in Canada is altogether different.

The climate of the greater part of this country is so severe in the winter that even the immense potentialities of its water powers, if fully developed, would be altogether inade-

quate to cope with the demand for power for electric heating if this were fostered to any considerable extent.

An attempt is here made to eradicate, if possible, from the popular mind, this idea that electricity is destined to take the place of coal or other fuels for the heating of houses, offices, etc., on an extensive scale; and, at the same time, to indicate in what manner electric energy may be most usefully and economically applied for heating purposes.

Advantages of Electric Heating.— Undoubtedly electric heating approaches more nearly to the ideal than that obtained by any other means. Electric heaters can be designed for operating at any desired temperature, *i.e.*, they may be arranged to work at a high temperature and give off radiant heat like a fire, or they may be designed for operation at a low temperature, like a hot-water or steam radiator, and give up their heat by convection, that is, the heat is convected (or conveyed), by setting the particles of air in motion, to various parts of a room. There is no dust, smoke, smell, or noxious gas from an electric heater, no soot, ashes, or dirt of any kind, and it does not vitiate the atmosphere by using up the oxygen; the heating can be under complete and ready control by the turning of a switch, thus decreasing or increasing the number of heating elements in service or shutting off the current entirely; automatic control by means of thermostats is, of course, possible. Electric heaters can be obtained in portable form, and there is less risk of fire from electric heating than from any other method.

Difficulties Preventing the Adoption of Electric Heating on a Large Scale.

No other system of heating can claim all these advantages. What, then, are the difficulties in the way of utilizing electricity for this purpose on a large scale?

The difficulties are two, viz.:—

(a) The enormous amount of energy that would be required and which could be more efficiently applied to other purposes.

(b) The high cost of electric energy for heating as compared with other sources of heat energy.

Explanation of the difficulties.—

It is necessary, in order that this article may fulfil its purpose, to enter into some explanation as to the reasons why these two difficulties exist, and to show that they are by no means imaginary or insignificant.

We are here concerned with energy in four well-known forms, viz.:

(a) Mechanical energy.

(b) Chemical energy (as in coal, oil, etc.)

(c) Electrical energy.

(d) Thermal energy (heat).

Any one of these forms of energy may be derived from any of the others, *i.e.*, under certain conditions, (a) may be derived from (b), (c) or (d); (b) may be derived from (a), (c) or (d), and similarly with (c) and (d).

A familiar illustration of the conversion of mechanical energy into heat energy is the primitive one of rubbing two sticks together to produce fire, and every one knows that hammering a bar of iron will make it warm; the

mechanical energy put into the rubbing or hammering is converted into heat energy, thus raising the temperature of the wood or iron as the case may be.

The reverse action is demonstrated when the steam in a kettle of boiling water raises the lid; in this case the heat energy in the steam, which has been received from the fire, is changed into the mechanical energy required to raise the weight of the lid; all steam engines are based on this principle.

That electric energy can be converted into either mechanical or heat energy is apparent to everybody in these days through the electric motors which drive our factories and run the street cars, and in the heat generated in electric heaters, toasters, smoothing irons, etc. The electric energy for these purposes is itself derived from the mechanical energy of falling water, or from a series of transformations of the energy in fuels, such as coal, oil, etc.; this series being the change, during combustion, of chemical energy in the fuel into heat energy, heat energy into mechanical energy, and this last into electrical energy.

Energy Cannot be Destroyed or Created—There is a great natural principle, known as the law of conservation of energy, which states that, no matter what transformations energy may undergo, no smallest part of it can be destroyed or created. This principle has been exhaustively tested by experiment for nearly a hundred years, and not the slightest deviation from it has ever been detected. Inventors of perpetual motion machines have endeavored for many years to obtain large amounts of energy from small amounts; but none have ever succeeded in doing so.

From this it follows that a definite relation exists between the various units by which energy in different forms is measured, which relation cannot be altered by means of special devices or machines. These relations or "equivalents" have been determined by experiment in a number of ways which have all given substantially the same results.

The relations with which we have here to deal are those which exist between electrical energy (measured in kilowatt-hours), heat (measured in British thermal units), and the chemical energy of coal. It has been definitely established that one kilowatt-hour (k.w.h.) is the equivalent of 3,411 British thermal units (B.t.u.), and that the chemical energy of one pound of anthracite is, on the average, equal to approximately 12,500 B.t.u. The chemical energy of 1 ton of hard coal is, therefore, equal to $2{,}000 \times 12{,}500 \div 3411 = 7{,}330$ k.w.h. of electrical energy.

While we are now in a position to compare the heating of houses by coal and by electricity on a basis of the number of tons of coal and equivalent number of kilowatt-hours of electrical energy, used in a year, there is another phase of the problem which must be taken into account, and that is, the question of storage of the energy until it is needed. In this respect coal and electrical energy are very different. A whole year's supply of coal can be stored in the summer and

used as needed, but no method has yet been discovered whereby electrical energy may be stored in appreciable amounts without enormous expense. Electrical energy is generated only a fraction of a second before it is used. It is evident, therefore, that the size of the generating plant and the capacity of the trasnmission lines and electrical equipment required to supply electricity for the heating of houses, depends, not on the amount of energy used per year, but on the *maximum rate at which the energy is to be used* even though that rate may persist for only a few hours in the year, *i.e.*, on the coldest days. This is a very important factor entering into the cost of electric heating.

The rate at which electrical *energy* is used or generated is known as the *power* (used or generated), and is measured in *kilowatts* or horse power (1 horse power = ¾ kilowatt nearly). The relation between the energy used (kilowatt-hours) and the power (kilowatts) is very simple. If a kilowatt be used for one hour the energy is 1 kilowatt-hour; similarly if 10 kilowatts be used for 1 hour or 1 kilowatt for 10 hours, the energy is 10 kilowatt hours.

The amount of power required for electric heating varies greatly throughout the year—none is necessary in the summer but on the cold days of winter much is required. In general, less will be used at night than in the daytime, but the *power* (*i.e.*, rate of use of energy) which determines the capacity of electric plant needed, is *the maximum power* or "demand," which will occur on the coldest day of the year. In order to find the relation between the amount of energy used and the "demand" an actual instance of a house which was heated by electricity in Toronto during the winter of 1917-1918 will be considered.

Actual Example of House Electrically Heated.

The house on which the test was carried out had nine rooms, and was heated from October 1st, 1917, to May 15th, 1918—7½ months. The temperature was kept at 70° Fahrenheit from 6.30 a.m. to 10 p.m., and slightly lower during the remainder of the 24 hours. The winter was somewhat colder than the average. No other source of heat was used. It was found that 52,700 kilowatt-hours were consumed in the season and the maximum demand was 19.4 kilowatts (26 horse power). Now since 7,330 kilowatt-hours are equal to the chemical energy of one ton of coal, 52,700 kilowatt-hours are equal to the chemical energy of 52,700 ÷ 7,300 = 7.2 tons of coal. That is to say, if all the energy in the coal could be usefully applied to heat the house, 7.2 tons of coal would be needed to perform the work accomplished by 52,700 kilowatt-hours of electrical energy, used at a maximum rate of 26 horse power. In actual practice, however, it is found that in burning coal or any fuel there is a certain unavoidable loss of heat, up the chimney, and in other ways, and tests have shown that in an ordinary house, even with the best attention, the average loss is not less than 35 per cent. of the total heat energy in the coal, and it may be 50 or 60 per cent. if the fire be care-

lessly handled. Let us say that 40 per cent. is lost, then the "efficiency" of the furnace would be stated at 60 per cent. *i.e.*, of each 100 heat units put in, in the form of coal, 60 are made use of in actually heating the house.

On converting electricity into heat there is no loss such as takes place with coal, and the efficiency is said, therefore, to be practically 100 per cent. It follows then that the coal actually required to do the work of 52,700 k.w.h. or 26 horse power is 7.2 x 100 ÷ 60 = 12 tons, and that 1 *ton of coal is the equivalent of* 2.2 *horse power or* 4,400 *k.w.h.*, when used for domestic heating. This sounds encouraging, but disappointment is in store.

Horse Power Required to Heat the Homes of Toronto.

The immensity of the task of heating the homes of Toronto with electricity is at once evident when it is considered that Toronto consumes about 900,000 tons of anthracite alone, which is practically all used for domestic heating. Nearly 2,000,000 horse power would be needed to replace the anthracite for heating alone, in addition to the power used for lighting, running factories and street cars, and more in proportion as the population increases. The great Queenston-Chippawa scheme at Niagara Falls only contemplates developing 275,000 horse power for the present, and the entire maximum demand of all Toronto at present, including all power, lighting and traction purposes is less than 150,000 horse power.

It may be added that the 6,000,000 h. p. which represents the estimated total possible development of Ontario water powers, is little more than half enough to supply merely the existing homes of Ontario with electric energy for heating alone, exclusive of all other domestic, commercial, and industrial requirements.

Energy for heating required in the winter.—A still further difficulty in supplying electric energy for heating on an extensive scale lies in the fact that all the heating is required in the winter only, and assuming that a maximum demand of 2,000,000 h.p. had to be met for supplying a city like Toronto, the load on the plant required for this purpose, throughout the summer months, would be practically nothing. In other words, for five months every year this enormous plant would be idle, and it would only be fully utilized for a few days in the year. Suggestions have been made that use might be made of it to supply certain industries which could be operated mainly during the summer months, but here there are two difficulties: (1) What are the industries on a large enough scale to be of any use? (2) How could such enormous undertakings afford to be idle during the winter months when power was unavailable? The situation in this case would be just about as bad for the industries in the winter as for the electric stations, without the industries in the summer.

Figures and statements such as the foregoing, which are based on incontrovertible facts, should once and for all answer the question in the negative as to whether the great water-powers

of Canada will ever entirely solve the fuel problem in a climate such as that of Ontario and Quebec.

Cost of Heating a House Electrically at Lowest Domestic Rates.

Turning to our second difficulty—that of high cost—it was found that, in the house mentioned above, 52,700 kilowatt-hours were needed. The lowest net domestic rate available in Ontario is 0.9 cents per kilowatt-hour—this means that the cost of heating the house would be \$474.30. People would not care to pay so large a bill for heating a 9-roomed house for a single season if they could do it for 12 x \$16.00=\$192.00, by means of anthracite, even if they had the satisfaction of eliminating dust, dirt, ashes, labour, etc. Were the rate even reduced to ½ cent, heating by coal would still be cheaper by 37% at least.

It has been assumed in the foregoing that the service charge for the house, at the standard Hydro-Electric Power Commission's rate of 3 cents per 100 square feet of floor area has been already paid for by the person living in it for his lighting service, and is not therefore charged against his heating account; but undoubtedly it would cost more to supply him with a maximum demand of 26 h.p. instead of, say, 1 to 5 h.p. for lighting, cooking, etc., and therefore an increased service charge would be essential; this, however, has not been reckoned in. This is very evident when it is considered that, to supply such an extra load for a large community, much larger meters, heavier overhead wires, stronger construction, bigger sub-stations, more powerful generating stations, and increased size of equipment in every way would be required.

Cost of Electric Heating if Current be Supplied at Lowest Power Rates.

With a demand of such magnitude in houses as is indicated above, it may be imagined that service might be given at power rates. This is, however, improbable on account of the differences in the conditions under which service is required. With ordinary power consumers, power is used as much in the summer as in the winter; its use is generally intermittent, and as a rule no two use the power at precisely the same times. As a result a "diversity" arises and the same electric plant capacity can be used to serve several consumers at different times. This is one of the things which enable low rates to be given for power.

With electric heating, however, little or no diversity occurs. All heating consumers need power at the same time, viz:—when the weather is cold, and there is no corresponding use of power in the summer. Moreover, the maximum demand for power for other purposes occurs in winter.

It will be interesting, however, to calculate the cost of heating even under the lowest power rates in Ontario and compare it with the cost of coal heating.

Taking for the sake of illustration the cheapest power rate of the Hydro-Electric Power Commission of Ontario; viz: that of Niagara Falls, Ont., the heating of a house similar to the

one tested in Toronto, which had a maximum demand of 26 h.p., and a total energy consumption of 52,700 k.w.h. per season (equivalent to 12 tons of anthracite) would work out as follows:-

NIAGARA FALLS POWER RATES

SERVICE RATE—

$1.00 per month per h.p. of maximum demand (if monthly maximum demand falls below 75% of highest previous maximum, this 75% is charged for).

CONSUMPTION RATES FOR ENERGY—

1.33 cents per k.w.h. for first 50 hours monthly use of demand.
0.667 cents per k.w.h. for next 50 hours monthly use of demand.
0.1 cents per k.w.h. for all remaining energy.

Discounts 25% and 10% on gross bill.

According to these rates the annual cost would be:—

SERVICE CHARGE—

For 2 months, 2 x 26 x $1.00			$ 52.00
For 10 months, 10 x 0.75 x 26 x $1.00			195.00

CONSUMPTION CHARGES—

For 2 months	1,940	k.w.h. at 1.33 cent	25.80
	1,940	k.w.h. at 0.667 cent	12.94
	14,680	k.w.h. at 0.1 cent	14.68
For 6 months	4,350	k.w.h. at 1.33 cent	57.86
	4,350	k.w.h. at 0.667 cent	29.01
	25,440	k.w.h. at 0.1 cent	25.44
	52,700	Gross Bill	$412.73
		Less 25%	103.18
			$309.55
		Less 10%	30.95

Total Bill for Season	$278.60
Net Cost per kilowatt-hour	0.53 cents
Equivalent price of anthracite, per ton 278.60÷12=	$23.22
Net cost per horse power	$10.72

It will be seen that, while, reckoned on this basis, and at the lowest existing power rates, the bill is considerably less than as calculated above on the ordinary lighting rate, yet the cost of heating by electricity is, even so, nearly one and one-half times that of heating with anthracite; the over-all

net cost per kilowatt-hour in this case equals 0.53 cent as compared with the net lighting rate (used above) of 0.9 cent per kw. hr.

Cost of Developing Two Million Horse Power.

The capital cost of furnishing two million horsepower to the city of Toronto, including hydro-electric development at Niagara Falls and all the switching and transforming equipment, together with transmission and distributing lines, etc., would probably be over half a billion dollars to deliver electricity to the consumers' houses —this means a capital investment of over $5,000 per house. This enormous sum, owing to the fact that the plant would be idle for nearly six months out of every twelve, as already pointed out, would, during half of its existence, be earning nothing, and the services of a large number of men would, of necessity, have to be retained throughout the summer months during the non-earning period in order that they might be available when required in the winter.

Thus the capital charges and running costs of such a plant, compared with its earning capacity, would be heavy. Annual charges on such a plant covering interest, sinking fund, depreciation, maintenance and operation, would amount to over $27 per horsepower-year. This plant would only be used for heating during a period of six or seven months, and the consumers would have to pay the charges for the whole year during this period.

Further, there would be but little "diversity," enabling the supply authority to make any reduction on this cost, as is possible with ordinary existing electricity supply, since the power would be required only in the cold season.

Efficiency of Various Methods of Heating.

The ultimate efficiency of heating, by any method, depends on two factors: one is the efficiency of transformation of the energy in the fuel, or of electrical energy, into available heat, and the other is the efficiency of application of the heat energy. For convenience, we will call these two efficiencies the physical efficiency and the efficiency of application, respectively.

The physical efficiency of electric heating may be considered as 100 per cent, while that of heating by fuels, *e.g.*, coal, gas, oil, etc., may vary from 30 to perhaps 70 per cent. The efficiency of application of either method of heating is a difficult matter to determine, as its ultimate value is only to be measured by the degree of comfort experienced by the person or persons, subjected to the heating effect in any particular case.

The point, however, that it is desired to bring out here is this: In the case of heating by fuels, engineers have still from 70 to 30 per cent. physical efficiency, according to circumstances, as room for improvement (it is not likely, however, that the whole of this will ever be utilized and possibly even under the most favorable conditions, 10 or 15 per cent. will always be lost, leaving from 60

to 15 per cent. as room for improvement), and in efficiency of application they have further scope, but of unknown extent. In the case of heating by electricity, however, there is no room whatever for improvement in physical efficiency as that is 100 per cent. already, while in efficiency of application there is the same, or possibly somewhat less room for improvement than with heating by fuels.

The fuel-heating engineers, then, have a very great advantage over the advocates of electric heating, for, should the latter, by improvements, be able to make the cost of electric heating at all comparable with other methods, the men handling the fuel-heating problems have, in a modern system, a margin for improvement (and consequent reduction of cost) in the physical efficiency, of probably 15 to 60 per cent., and as much as, or more than, electrical men, in the efficiency of application.

Besides the effect which these two efficiencies have on the relative costs of heating by fuels and by electricity, there is to be considered the relative prices of these commodities. In the case of coal and electricity dealt with above, coal at $16.00 per ton is very much cheaper than electricity at 0.53 cent per k.w.h.

The cost of coal would have to rise to not less than $23.00 per ton before the cost of heating by means of it equalled that of heating by electricity even at the lowest rate existing in Ontario at the source of power. (See "Cost of Electric Heating if Current be Supplied at Power Rates" above.)

It is, therefore, hard to conceive of a time when electric energy will compete successfully and on a large scale with coal, oil, gas, etc., for heating.

Electric Heating Auxiliary to Other Systems in Mild Weather.

While it has been shown above that in point of economy electricity cannot compare with coal for heating throughout the winter, yet electrical energy may be usefully employed for heating in mild weather with little or no extra cost, and with a great gain in comfort and convenience. When it is said that the efficiency of the coal furnace is from 30% to 70%, reference is made to the *average* efficiency throughout the heating season. The daily efficiency of the coal furnace, however, varies greatly, depending on the outside temperature and the rate at which coal is burnt. Thus in the winter, when the furnace is operated at or near its capacity, the efficiency is better than the average, while in autumn and spring the efficiency is often much lower than the average. The lower efficiency in mild weather is the result of losses consequent upon the necessity of lighting and extinguishing fires, the impossibility of accurately regulating a furnace designed for use in the coldest weather so as to give off a small amount of heat, poorer draft and slower circulation of hot air or water in the house.

It is obvious that the poorer the efficiency, the greater the cost of coal heating, and therefore it is in the mild weather that the cost of heating with coal most nearly approaches, and may even exceed, the cost of heating with

electricity. The difficulty of the large capacity required for heating in cold weather does not apply in mild weather. The convenience, cleanliness and flexibility of heating with electricity in mild weather do not need to be enlarged upon.

It is equally obvious, however, that in the cold weather when the furnace can be operated to maximum efficiency, the difference between its cost and that of electric heating is greatest. Coal should, therefore, be used during the cold weather of winter, and electricity during the mild and uncertain weather of spring and fall.

Use of Off-Peak Power not Feasible.

The suggestion has been advanced that the cost of electric heating might be reduced if off-peak power were used to heat large tanks of water at night, and so store the heat for use in the day time. It is plausibly argued that since the cost of power to the municipality is on a basis of maximum demand, off-peak power costs nothing and any revenue derived from such electric heating is therefore practically pure gain. While it is true that the purchase of off-peak power costs the municipality very little, this is by no means the case as regards the cost of distribution within the municipality. Let us consider what the cost would be if the house considered above were heated by off-peak power.

Only about eight hours of off-peak power daily can be depended upon out of the 24. Hence to obtain the same amount of energy in eight hours as was furnished by 26 horse power in 24 hours, there would be a maximum demand of $24 \times 26 \div 8 = 78$ horse power. The efficiency of heating would be reduced considerably owing to the impossibility of eliminating all heat losses from the storage tanks. Probably at least 90 horse power and 60,000 k.w.h. would therefore be required to produce the same useful heating effect.

The cost of service on this basis under Niagara Falls power rates would be approximately as follows:

Service Charge—		
2 months		$180.00
10 months		675.00
Energy Charge—		
2 months	6,714 k.w.h. at 1.33c.	$ 89.30
	6,714 k.w.h. at 0.667c.	44.78
	7,000 k.w.h. at 0.10c.	7.00
6 months	15,106 k.w.h. at 1.33c.	200.91
	15,106 k.w.h. at 0.667c.	100.76
	9,360 k.w.h. at 0.10c.	9.36
		$1,307.11

Brought forward	$1,307.11
Less 25%	$ 326.78
	$ 980.33
Less 10%	98.03
	$ 882.30
33⅓% Discount for off-peak power *(The largest class discount authorized)*	294.10
Net Bill for off-peak power	$ 588.20
Equivalent price of coal, per ton	$ 49.00

It is evident from the above that even allowing an extra discount of 33⅓%, the cost of heating by off-peak power under the cheapest power rates would be double that of heating with 24 hour power, and more than three times that of heating by coal.

In the foregoing no consideration has been given to the capital cost to the consumer of his electric heating installation and the necessary large water tank of a capacity sufficient to take care of 90 horse power and heat storage for 16 hours.

Possibilities of Using Electricity for Reducing Cost of Ordinary Methods of Heating.

Again, at present rates for electric current, it is likely that considerable reductions may be made in the cost of heating by the judicious use of electric fans to thoroughly circulate the air from the radiator or register and bring all parts of the room to approximately the same temperature; the extra cost of current required for a fan is very small compared with the advantage to be gained.

In one case, it is reported that satisfactory results were obtained by placing a fan, pointed slightly downwards, behind the radiator and blowing the warm air across the floor of the room. The effect of this is to make the warm air first circulate around the feet of the occupants of the room, and it is said to give a general sense of comfort which is entirely absent when the feet are cold although the upper part of the body may be warm. This scheme is, of course, applicable to steam, water, or hot-air heating.

Any method of improving the circulation of air in a room will result in greater comfort, provided that the creation of draughts is avoided, as the general tendency of comparatively undisturbed air is to arrange itself in strata of various temperatures, the higher temperatures being, of course, found near the ceiling. According to tests recorded in the *Electrical World* for February 22, 1918, the following temperatures were found at various levels in a room:—

Distance above floor in inches.	Temperatures—Degrees F.
124	83
108	80
93	80
64	76
44	74
31	68
4	66
0	62

It will be seen from the foregoing that while the feet of a person sitting down would be at 62° F., which is too cool for comfort, his head would be at about 75° F., which is too warm, particularly so when his head is hotter than his feet, and also that the temperature at the ceiling is the excessive one of 83° F.

The writer of the article in question states that "the total amount of heat in the room was sufficient to make the whole room approximately 74 degrees—greatly in excess of what is necessary or desirable." In such a case, if the heated air at the ceiling were circulated throughout the room by means, say, of an electric fan, the quantity of heat required, and consequently the cost of heating, might be appreciably reduced.

Conclusion

Regarding the future outlook for the use of electric energy for heating, it may be said that to push the matter on an extended scale would be economically unsound in Canada, where such enormous amounts of energy would be required for this purpose alone, as all other fields of application for electric energy would suffer seriously thereby.

At existing rates for coal and other fuels, compared with those for electricity, electric heating is too expensive to be adopted extensively, but as an auxiliary its advantages are so attractive that efforts will undoubtedly be made to reduce the cost so as to make its use in this way more popular.

Appendix

It has been shown in this pamphlet that *for domestic heating purposes* an electrical horse power of maximum demand is required to replace less than one-half ton of coal. At first glance this appears to be contradicted by frequent authoritative statements which are made from time to time to the effect that an electrical horse power is the equivalent of from 10 to 20 tons of coal, but on maturer consideration it will be seen that there is no contradiction involved. The reasons are two:—First, the low load factor of the winter heating load; and second, the fact that although electricity can be converted to useful heat at very high efficiency, the heat derived from coal can only to a very partial extent be converted into electricity. Even in the most efficient commercial steam-electric generating stations a maximum of from 12 to 15 per cent. of the chemical energy in the coal is converted into electricity, and moreover it is very improbable that this efficiency will ever be increased to more than 20% in commercial practice. Small stations have usually lower efficiencies—some are below 3%.

The one equivalent represents the number of horse power which, at the load factor of winter heating require-

ments, would be needed to give as much heat as a ton of coal; the other represents the amount of coal required to generate one electrical horse power at a stated load factor (usually 100%).

The wastefulness both of using electricity instead of coal for heating and of using coal for the production of electricity is evident when it is considered that of the coal only about 12% can be converted into electricity, and if this latter be used for heating, less than 1/6 of the heating effect is obtained that could have been utilized from the coal direct.

True conservation, therefore, lies in using, to the fullest practicable extent, water-power for the generation of mechanical power and fuels for heating. Where no water-power is available, then the fuels must, of necessity, be used for mechanical power purposes, but this will preferably be done in large electric generating stations, the electric energy from which will be converted into mechanical power by means of electric motors, and again the fuels should preferably be used directly for the purposes of heating without converting their energy first into electricity and then into heat.

The question of using electric energy for mechanical power purposes has been taken up very seriously in England since the war broke out, as a means of conserving coal supplies. The Coal Conservation Sub-Committee of the Reconstruction Committee of Great Britain in a report presented to Parliament on April 17, 1917, on Electric Power Supply in Great Britain, states:—

"Power may be most efficiently applied to industry by the medium of electricity. . . . The question which has been settled conclusively during the past fifteen years is that the most economical means of applying power to industry is the electric motor, which, on account of its high efficiency, has ruled out all rivals so far as the workshop itself is concerned. In the factories put down for the production of munitions during the war, 95 per cent. of the machinery is driven by means of electricity, and it is only a question of time for all power to be applied in this way."

It is shown in the report that a saving of some 60,000,000 (short) tons of coal could be made annually in Great Britain by using it only in very large stations, and adopting electricity universally for the production of mechanical power.

The saving shown is that represented by the difference in efficiency of many isolated plants and a few very large ones, but, as has been stated above, the efficiency, even in the latter, is not more than 12 or 15 per cent., and cannot possibly be raised very much higher.

In Canada, however, fuels, instead of being used at 15 per cent. efficiency for power, can be replaced by hydro-electric energy at five times this efficiency; thus, this would result in saving all the fuel so replaced for heating, under which conditions it can be utilized at several times the efficiency which it would yield for power purposes.

It must not be supposed that the foregoing statements apply to the use of electric energy for such special

heating requirements as those of electric furnaces, electric welding, cooking and the like, in which the advantages of heat so obtained are very great and the aggregate power likely to be required will not run into millions of horse power for any one purpose, nor the demand for such heating be confined specially to any one season.

Guided Wave Communication on the Niagara System

About eighteen months ago the Hydro-Electric Power Commission of Ontario decided to develop a system of guided wave telephony for use in case of trouble on the physical telephone circuits of the Niagara System. A considerable amount of research and development work has now been done on both the apparatus and aerials. As a result of this work a communication system as described in the following paragraphs is being installed.

Aerials.

The points between which communication is to be established are the high tension transformer stations in various locations on the System. At each of these, two aerials are strung on the towers about 25 feet below the power conductors and for a distance of 2,500 feet from the station.

For ground construction, the steel framework of the building and also the water pipes are used.

Transmitters.

The transmitters each have a capacity of 5 watts, *i.e.*, one 5 watt oscillating tube and one 5 watt modulator tube are used.

For power supply, a small dynamotor is operated from the 12 volt storage battery supplying the filaments of both tubes. This dynamotor generates a voltage of 500 volts which is applied to the plates of both tubes.

The aerial coils of the transmitter with a small fixed condenser in series are placed directly between the aerial and ground. Across these coils is bridged the primary circuit of the receiver, protected from low frequency surges by two small fixed condensers.

Receivers

The receivers are of the regenerative type with one stage of amplification. Radiotron No. U.V. 201 valves are used for both detecting and amplifying.

To supply the filaments, a 6 volt storage battery separate from the one required for the transmitter, is used, and the power for the plate circuits is obtained from small dry cells; for the detector 35 volts and for the amplifier 70 volts.

Operation

The transmitters and receivers are of the same design as used for straight radio communication and are

operated in precisely the same manner as if the aerials were not in the proximity of power lines. The power conductors, however, guide the radio waves, and although a certain amount of energy is re-radiated from them, the energy reaching the aerial at the receiving end is much greater than would be obtained without their guiding effect.

The system is, therefore, more efficient and at the same time gives greater secrecy than a system using unguided radio waves.

DISTANCES.

While the range of these sets for straight radio communication would not likely be greater than eight to ten miles, quite satisfactory communication is obtained between transformer stations fifty miles apart when the power conductors are used in this way as a guide.

In a later issue of THE BULLETIN we will give a more complete description of this method of communication, with illustrations of the equipment we are using.

HYDRO NEWS ITEMS

Central Ontario System

The Commission put on a demonstration at the Provincial Plowing Match at Lindsay showing farm power and domestic equipment in operation. Service was also supplied to other exhibitors.

* * *

The Corporation of Oshawa has asked the Commission to install 130 new street lights. A large percentage of these lights are for new streets which have been opened up in the last two years.

* * *

The Commission's Pulp Mill, at Cambellford, was re-opened on September 11th, after a period of inactivity, due to poor market conditions. The mill is operating at full capacity and has orders ahead for some weeks.

* * *

Niagara System

A contract has recently been signed with a tile company for a plant located at Fletcher. It is proposed to construct a 26,000 volt station at Fletcher and build a 4,000 volt line from Fletcher to Merlin, which municipality has recently signed a contract for power with the Commission. It is expected that work on the line to Fletcher and Merlin will be commenced very shortly, and the remodeling of the distribution system in the Police Village of Merlin will be proceeded with at once. Power should be available for Merlin before the New Year.

* * *

The Municipality of Kitchener is at the present time arranging for an additional debenture issue of $80,000 to cover extensions and improvements to the local distribution system, to take care of the rapidly growing load. Arrangements are being made to instal a number of underground circuits from the Commission's high tension station to the municipal sub-station.

* * *

The work of constructing a line from Essex High Tension Station to Belle River, and the distribution system in Belle River, is progressing very rapidly and service should be available to the Municipality by December 1st.

* * *

Rideau System

At the request of a number of manufacturers on the System, through the Perth Commission, this Commission had a representative visit the Municipality of Perth and go into detail on the finances of the System with the power users.

St. Lawrence System

The transmission voltage of this system was changed on the 1st of October to 44,000 volts, preparation having been made for this during the summer months. The change was made without any unusual incidents taking place. The former transmission voltage was 26,000, and the changes required to transmit at 44,000 volts comprised re-building of about 60 miles of transmission lines and the altering of several substations on the System. All construction on this system since 1918 has been done with a view to ultimately operating at this voltage, and the necessity for the change arose out of having to secure the power from Cornwall (Cedars Rapids Transmission Company), whereas, initially, when the System was conceived, it was the intention to obtain the power from the New York and Ontario Power Company at Waddington, N.Y., opposite Morrisburg.

* * *

The Eugene Phillips Electrical Works will take service some time during this month, and its new plant at Brockville will be in production before the end of the month. This Company's requirements are the direct cause of having to make the radical changes in the System, as above mentioned.

* * *

A report has been forwarded to the Municipality of Cardinal, setting out the cost of power delivered to the Municipality on the basis of the municipality taking 75 horse power from the Commission's transmission lines which pass through that municipality. The Municipality was also supplied with information on the cost of a distribution system, and the total annual cost of operating the same. An estimate of the revenue and the rates which the Commission advise using were also supplied to the Municipality.

The Municipality has further requested the Commission to report on the purchase of the distribution system of the Cardinal Electric Light Company.

* * *

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It is but two decades ago since the people of Ontario began to talk of the possibility of obtaining electrical energy from Niagara Falls for use in towns and cities lying at considerable distances from that source. When a subject of talk has the appearance of plausibility, it is at least worthy of investigation. The early investigations that led up to the formation of The Hydro-Electric Power Commission of Ontario, are outlined in the second article on the history of the Commission as given herein.

When Mr. D. B. Detweiller and Mr. E. W. B. Snyder took it upon themselves to call a meeting of municipal representatives to discuss informally the idea of obtaining power from Niagara Falls, they no doubt saw where great benefits would result within a limited field. It is very doubtful, however, whether these men even dreamed that out of that meeting would develop one of the greatest organizations for the generation and transmission of electrical power, and that in less than twenty years.

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Servicing Electrical Appliances

With the sale of an electrical appliance the interest of the Utility does not cease. A small revenue may have been obtained by its sale, but a greater revenue will result from its continual use. With this in his mind each Hydro shop manager will appreciate the several points brought out by the article given herein, and imitate the following suggestions:

1. Keep electrical appliances in constant use by frequent inspection of consumers' installations. Consumers appreciate the unsolicited attention given appliances, and this service is amply rewarded by the patronage given for future business and the advertising given to neighbors.

2. Use the service call as a means of introducing other useful appliances, or suggesting the conveniences possible by their use. Propaganda such as this properly disseminated, is bound to sell appliances otherwise never thought of.

3. Promptness in repairing and servicing appliances. Nothing gives a customer more cause for complaint and dissatisfaction as to be without a useful appliances unnecessarily.

4. Keep up the standard of quality of electrical appliances. *Do not sell cheap things, they are dear at any price.*

History of the Hydro-Electric Power Commission

NO. 2

Genesis of the Hydro-Electric Power Commission—Reports of the First Commissions

By E. B. BIGGAR

AFTER preliminary local discussions an informal convention was held in June, 1902, at the town of Berlin (now the City of Kitchener), the delegates comprising representatives from a number of cities and towns extending from the Niagara district as far north as Toronto and as far west as London.

The chair was occupied by Mr. E. W. B. Snider, a manufacturer of St. Jacobs, who afterwards became chairman of the first power commission of the province.

There were two classes represented at the meeting: those who desired to obtain cheap power as manufacturers, and those who had the public service needs of the municipalities in mind; but both were unanimous in looking to Niagara as the only source of cheaper power. Alderman F. S. Spence of Toronto, one of the first and most consistent champions of the complete ownership of electrical distribution systems by the municipalities, first proposed that the municipalities should unite in asking the Ontario Government to appoint a government commission invested with power to arrange for the transmission of electrical energy to such cities, towns and villages as desired to take power. This commission, he suggested, would issue bonds to cover the cost of the transmission lines, and

these bonds would then be covered by the bonds of the participating municipalities and deposited with the commission. The municipalities would in effect, buy power from the commission, which would own the main lines, and in turn sell power to manufacturers, and while supplying power and light for municipal purposes would furnish light to the citizens at an even rate. This would prevent the power and lighting services from falling into the hands of private monopolies, and would secure to the industries of the province the advantage of much cheaper electrical energy than was obtainable from private companies.

After various proposals were made —one of them being the formation of a joint stock company by the manufacturers of the different towns for their common purpose, and incidentally the supply of light and power for general use—the meeting adjourned, and in July another meeting of representatives of these municipal councils was held at Berlin. Messrs. E. W. B. Snider, D. B. Detweiler, of Berlin, who had acted as secretary, and F. S. Spence, of Toronto, were at this meeting, appointed a committee to obtain information. The committee reported to a meeting held in Berlin, February 17th, 1903. So strong had become the public interest in the movement, that at this meeting about ninety municipalities and individual manufacturers were represented, including Toronto, Stratford, London, St. Thomas, Woodstock, Ingersoll, Guelph, Hamilton, St. Catharines, Brantford, Waterloo, Galt, Berlin, St. Mary's, St. Jacobs, Bridgeport, etc.

The committee recommended an application to the legislature for authority to develop, transmit, buy and sell electrical energy and to permit the municipalities to co-operate to distribute the same. After discussion the following resolution was submitted by Mayor Urquhart, of Toronto:

That we respectively urge upon the government of Ontario the advisability of the government building and operating as a government work, lines for the transmission of electricity from Niagara Falls to the towns and cities of Ontario, or that they extend the powers of the present Niagara Falls Park Commission so that they may as a public work build and operate the necessary lines to transmit electric energy from Niagara Falls, and that for this purpose they be empowered to issue debentures which might be guaranteed by the Government, but which would eventually be paid out of the receipts from the sale of electrical energy, thus entailing no charge on the provincial funds, and that the municipalities here represented call their representatives in the legislature to urge on the government to carry out this resolution. After an amendment striking out the reference to the park commission the resolution was adopted, along with another resolution asking the government not to part with any more power privileges to private parties.

The subject of Niagara power continued to be agitated in the towns and villages represented at the first conferences. The council of Guelph demanded, and afterwards acquired,

possession of the electric lighting plant hitherto carried on there by a private company. In the case of Toronto there was a strong movement in favor of obtaining a transmission line direct to Toronto for the purpose of that city alone, and in January, 1903, application was actually made to the legislature for the right to generate and transmit Niagara power.

The Ontario legislature refused the application of Toronto on the ground that the city had no matured plan for exercising the powers asked for, but the refusal was no doubt influenced—apart from the efforts of the private corporations to choke off competition—by the objections of other municipalities, where the people held that if Toronto were to have its independent line they would be handicapped in financing a separate system for relatively small communities. Members of the government, including the premier, Hon. Geo. W. Ross, took the stand that the financial obligations involved both in the Toronto proposition and in the plan proposed at the conference in Berlin were for the benefit of that section within electrical reach of Niagara, and that the whole province should not be called on to subsidize one section, thus giving it an industrial advantage over other regions beyond transmission distance.

While the legislature was thus putting Toronto and the other municipalities to such a test as to "a matured scheme," as was not applied to private corporations, we find that at this time the owners of the Toronto and Mimico Railway Co. (electric) was applying for power to extend its line to Hamilton; and the Toronto Electric Light Co. was making application for the sole right to power on the Canadian side of the Niagara. The Union of Municipalities opposed this and obtained the support of civic corporations as far away as Winnipeg.

Events were now moving fast, and the light of Niagara was beginning to penetrate the legislative chamber at Toronto. Led by Ald. Spence, the Toronto Council now threw in its lot unreservedly with the other civic bodies, whose next meeting was held in that city in February, 1903. Ald. Spence declared that what the cities and towns wanted was cheap power, and it seemed to him that municipal ownership under government control was the best means of obtaining it. Other speakers reported that the towns of this region were more deeply interested than ever.

A large delegation from the municipalities now interviewed the premier and found him more disposed to consider their claims. Discontent with his administration on other grounds probably had its influence in this change of attitude. Mr. Snider, of St. Jacobs, pointed out the loss that would ensue if these towns were to struggle on with the high cost of steam-raised power while other places had the advantage of power at half the cost. It was estimated that 20,000 to 25,000 h.p. could be used by these towns, exclusive of Hamilton and Toronto. If the government would not go on with the work the next best thing was to allow the municipalities to do it. Ald. Spence reminded the Premier that the government had spent large sums in developing the

mineral resources of the province, and rightly; but the mineral resources may one day be exhausted, while the resources of Niagara power may be deemed to be eternal. If this resource were placed in the hands of the people the aim would be to secure their largest possible use at the lowest cost; and he was confident that if their plan were carried out the present cost of power would be cut in two. He suggested the municipal co-operative plan under a commission of three to five men; and to prevent the distribution plan from being held up, authority should be given to enable them to develop power also.

In reply, Premier Ross said he was informed that the power now provided for at Niagara could not be used for a quarter of a century to come. The government could not directly undertake the scheme but, with the assistance of those concerned, would bring in a bill enabling the municipalities to carry out their plan.

The government was more seriously concerned with the power question when the leader of the opposition, Mr. James P. Whitney, in a speech at Newmarket, at this time, protested that the granting of a third power franchise at Niagara was all wrong, as was the unrestricted export of the power already developed. As for the argument that this was a matter of sectional advantage, the premier forgot that large sums had been devoted to the development of New Ontario, yet the whole province was asked to pay for it. Mr. Whitney held that the government should investigate the problem of supplying power to all places within 150 miles of Niagara, or appoint a commission to provide the means of enabling the Union of Municipalities to do so.

To bring some fresh light to bear on the question of public ownership the government, in May, appointed a special committee to report on the municipal ownership or operation of public utilities. Mr. Avern Pardoe, was appointed secretary, and his report was the most comprehensive compilation of information on the subject up to this time in Canada. In it appeared the first return of the municipal activities of the province, and this has been maintained annually since as the report on the "Reproductive Undertakings of Ontario Municipalities." This report though incomplete, showed that 126 municipalities in Ontario were now operating their own waterworks, electric light and gas works, the majority of these services having been taken over within the preceding ten years.

With these evidences of the trend of public opinion before them, the government at least made good its promise, and in June of this year passed an Act for the "Construction of Municipal Power Works and the Transmission, Distribution and Supply of Electrical and other Power and Energy." It gave any two or more municipalities the authority to appoint commissioners to examine into and report upon the establishment of works for producing power, heat and light, the probable cost and desirability of the undertaking and the proportion of cost to be borne by each of the contracting bodies. It conferred on the municipalities the power to act on the report of the commis-

sioners and to establish the works under a Board of Commissioners to be nominated by the Chief Justice of Ontario. The Board would have the power to acquire or construct works for generating, transmitting and distributing electricity, or other power, and fix the rates to be charged in each case. Finally, authority was given for the issue of bonds for carrying out such works; and the Act directed that in the event of such commission being appointed the commissioners should report to the appointing municipalities particulars as to the power required and consumed, the capital cost and operating costs, with the share of each, rates, etc., and that before action, the proposal should be submitted to a vote of the electors through a by-law.

Under the provisions of this Act representatives of seven municipalities — Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph — met in Toronto in August, 1903, and appointed an investigating committee composed of Messrs. E. W. B. Snider, of St. Jacobs (chairman); P. W. Ellis, of Toronto; W. F. Cockshutt, Brantford; Adam Beck, London; and R. A. Fessenden, electrical engineer, of Washington, D.C. J. C. Haight, barrister, of Waterloo, acted as honorary secretary. All commissioners gave their services free, except for a nominal fee paid to Prof. Fessenden. Messrs. Ross & Holgate, engineers, of Montreal, who were appointed to make the technical investigations, gave their services at cost. The fund for the investigation was provided, not by the Provincial Government, but by municipal subscriptions amounting to $16,000, of which Toronto contributed $11,756, and London $1,542.

No statistics of power consumption were then available, but Mr. Ross opened an office in Toronto, and a staff of engineers was organized to canvass from factory to factory, to explain the advantages of conversion from steam to hydro-electric power, and to learn to what extent the power users would co-operate in the movement. In addition to the prejudice of many steam users who did not admit the superiority of electric power, and who imagined that the winter's heating which they got from the exhaust-steam of their engine, cost them nothing, it was found that many firms had recently been tied up in long-term contracts with the electric company.

Meantime the investigations under Mr. Cecil B. Smith, to be referred to hereafter, were proceeding in the wider field outside of Toronto and carried on with such speed and energy that the two reports were given to the interested municipalities and to the public within a few days of each other in March, 1906.

Dealing with the criticism anticipated from opponents of public ownership, the commissioners, in their comments on the Ross & Holgate figures, said: "The basal fact that power and light can be supplied under a municipal development, properly carried out, under engineering conditions equal to those of its competitors, at prices beyond the reach of permanent commercial competition, is not open to argument. Competing (private) companies have to pay higher interest rates on their bonded debt,

and in addition they have large issues of capital stock on which dividends have to be earned. Whether rates be fixed by the companies voluntarily or under Government regulation, regard must be paid to these conditions and the rates loaded accordingly. No criticism directed at isolated facts or figures will alter these broad underlying conditions, from which the general public will derive benefits otherwise unattainable." The commissioners did not think private companies could complain of municipal competition, for the private trader and manufacturer has to face the risks of loss and the competition of rival businesses, and expects no indemnity from the consequences of this competition. Moreover, the industrial future of the province depended on the leverage of the new power.

In conclusion, the commissioners recommended that the municipal development be carried out, and suggested a fourth site in the Niagara Falls Park for the proposed installation, which would require two or three years to complete.

While the work of this commission was being discussed before the actual publication of its report, a new election was held, resulting in the defeat of the Government, and the advent to power of the Opposition leader, Hon. James P. Whitney, who had been a strong opponent of the private monopoly of the water powers. During the campaign preceding the election, he had said that Niagara power should be as "free as the air," and this expression was scoffed at by the power magnates as a proof that the idea of public ownership was utterly visionary. What Mr. Whitney meant, as he explained, was not that Niagara power would cost nothing to develop, but that the opportunity for its use should be available on equal terms and free from the exactions of private monopolists. On coming into office he lost no time in demonstrating his sincerity regarding the hydraulic power question. The result was that the first municipal power Act was repealed, and on the 5th of July, 1905, an Act was passed creating a "Hydro-Electric Power Commission of Ontario."

Mr. Adam Beck, Mayor of London, had been elected to represent that city in the Legislature, and having, as a member of the investigating commission, made an earnest study of the problem, was invited to become a member of the Cabinet, for the purpose of working out a power policy for the province. As a large manufacturer, he was familiar with the industrial requirements, and by his experience in municipal affairs he had gained a thorough understanding of the huge obstacles to be overcome before complete co-operation could be attained among the municipalities. In choosing as chairman of the commission a man of such experience and of such abounding energy and steadiness of purpose, the judgment of the new Premier was to be amply justified by public opinion. Mr. George Pattinson, of Preston, also a member of the Legislature, and Mr. P. W. Ellis, of Toronto, were the other commissioners.

The demand that the great water powers of Canada should be controlled in the public interest now

became general. Not one Niagara, but many Niagaras, could be dealt with. The commission met this demand in a statesmanlike way. It secured the services of Mr. Cecil B. Smith, a young Canadian engineer of great ability, who had been resident engineer of the Canadian Niagara Power Co., and under his direction a great public service was rendered to the province by a comprehensive survey of the water power resources of the more settled regions of Ontario. Five reports were issued in succession within about a year. The first report covered the region from Niagara Falls westward to the Detroit and St. Clair Rivers, and reaching to Toronto on the north; the second, the Trent district, so called, north of Lake Ontario and embracing the watersheds of the Trent and Moira Rivers; the third report dealt with the counties whose rivers chiefly flowed into Lake Huron and Georgian Bay; the fourth report treated of the Lower Ottawa and Upper St. Lawrence regions, comprising the eastern counties of the province; while the fifth considered in a general way the water powers of the great, but as yet sparsely settled, territory in the districts of Algoma, Thunder Bay and Rainy River to the north and east of Lake Superior.

The reports of the investigating commissions were extensively quoted in the newspapers and discussed by boards of trade and other public bodies. The two reports, while differing in details and in methods of computation, agreed in the main as to the market that could be created for power and the savings that might be made by a wisely administered co-operative system compared with the private company service. These publications made a deep impression, as the data on which the reports were based came from hydraulic and electrical engineers of undoubted standing.

In one paragraph of the report of the Hydro-Electric Power Commission, it was stated that the tendency with private corporations was "to amalgamate or otherwise destroy competition, and then fix the price according to the slight saving which they may be able to induce particular customers to make. The natural result of this has been to force individual power consumers, where the circumstances justified it, to instal generating plants of their own, rather than to place themselves at the mercy of large combinations formed for the purpose of preventing competition. The same result, of course, occurs where there has never been a competing company. Specific illustrations of this are found in the cities of Montreal, Buffalo and Hamilton. On the other hand, in the city of Ottawa, where the municipality secured a distributing plant, in anticipation of an attempt to throttle competition by a combination of companies, lower prices prevail, based on the cost of production."

A staff of seven hydraulic and electrical engineers was organized by the new commission to make a survey of the water powers developed in the districts mentioned, and to report the present and prospective demand for hydro-electric power; to estimate the capacity of the water powers and the capital cost of their development, including cost of trans-

mission lines to the various centres of consumption; the prices that would require to be charged to cover the cost of operation and maintenance; and to estimate the savings to consumers compared with prices now charged. The commissioners were also asked to obtain information regarding existing private developments, such as their cost and the rates charged. A canvass was made by expert assistants in each town and district, and by this means it was learned how many of the present users of power would adopt electricity if available at a saving in cost. An immense amount of information was gathered in these reports, which constituted the first hydro-electric power census of Ontario. Comparisons were also made between hydro-electric power and steam-generated power or gas power, so that the municipalities in each subdivision of a district might know the bearing of a hydro-electric system upon their own particular needs.

At this time the Canadian Niagara Power Co. was only generating about 17,000 h.p., of which 15,000 h.p. was sold to the Niagara Falls Power Co. on the New York side. The Ontario Power Co. was not yet ready to deliver the first units of the 30,000 h.p. which it had contracted for in New York State. The Electrical Development Co. was installing its first 50.000 h.p. for Toronto, but this would not be ready till 1907.

The Hydro-Electric Power Commission estimated that it would require four years to complete a plant at the only commendable site available, and consequently advised that the municipalities should build their own transmission lines and purchase the power that was then begging for customers. The Hon. Mr. Beck had declared that he was not antagonistic to capital nor to private corporations, and the fact that the Commission soon afterwards made a contract with the Ontario Power Co. for 100,000 h.p. verified his statement. It was the unbridged gulf between the cost of service for public purposes and the rates actually charged, that determined the municipalities to go forward. At a large public meeting in Toronto, on the 10th April, 1906, it was reported from Fort William that that city was obtaining electric power at $15 per h.p., and the town of Orillia reported to the same meeting that its municipally owned hydro-electric plant was selling power to Orillia manufacturers at $16 per h.p. per year. On the following day a deputation numbering nearly a thousand, and representing seventy municipalities from Sarnia on the west to Kingston on the east, waited on Premier Whitney, urging Government action. The Premier said the difficulties were great, but the Government was not frightened at this, and would undertake either the transmission of electricity or the control of the prices to be charged, so that the interest of the people should not be sacrificed.

Walkerville Hydro-Electric System Office Building

THE latter part of last year the Hydro-Electric Commission of Walkerville decided to erect a building to house its general offices and Hydro shop. Previous to this year the Walkerville System had been renting quarters, consisting of a double store, which provided space for both offices and Hydro shop. In the past few years, however, the business transacted by the System has grown to such an extent, that the old quarters were entirely inadequate, consequently property was purchased, plans prepared and actual construction work on the new building was started on the first of April this year. This building was completed on October 28th, and the Walkerville System proceeded to occupy the same on the first of November.

The building which has been erected is of solid type construction, and presents a very dignified appearance. It is located on the corner of Wyandotte Street and Argyle Road, Walkerville, Wyandotte Street being the main business street of Walkerville. The building is practically of fireproof construction, being erected of re-inforced concrete, steel, cut-stone and brick with all steel window sash. The exterior walls on the Wyandotte Street and Argyle Road elevations are of cut Indiana Blue-stone for the first storey, with Milton pressed brick and Indiana Blue-stone Trim on the second storey. The other exterior walls are brick.

The building is located on a lot 60 ft. frontage by 100 ft. on Argyle Rd., and the building itself is 60 ft. by 72 ft., with a paved court yard at the rear 28 ft. by 60 ft. The building is 33 ft. high, two storey construction, with full basement. The first storey is 20 ft., and the second storey 11 ft. high. Large show windows are located on the Wyandotte Street frontage, and large display windows giving a view of the whole main floor are placed on the Argyle Road side. The main entrance is located in the centre of the Wyandotte Street elevation and there is a second entrance on the Argyle Road side.

Ample provision has been made for the loading and un-loading of merchandise at the rear of the building, where a large entrance at grade level, as well as a second entrance at truck level directly on to the freight elevator, has been provided. Sufficient light and ventilation has been provided through the large amount of window space on all exterior walls.

The interior woodwork throughout the building is of chestnut, finished with oak stain, and presents a very pleasing appearance. The plaster trim is sand finish and not decorated, and consequently conforms very well to the general interior decoration. All stairways with railings are of orna-

General Office, Walkerville System

mental iron and steel construction, with dull black finish. The main floor ceiling and the walls in the rear show window are very simply panelled in plaster, providing a very pleasant relief in these extensive plastered sections. The main floor in the display room is finished in terrazzo, while the floors in the windows and all office spaces consist of battleship linoleum, laid on concrete.

The main floor of the building is largely devoted to display and demonstration spaces for electric appliances. The show windows at the front, four in number, are each 12 ft. x 10 ft., x 12 ft. high and provide ample space for the display of all classes of electric appliances. The main sales floor space is approximately 58 ft. by 44 ft., having a model kitchen and model living room on the west side. The model kitchen is fitted out for the demonstration of electric ranges, water heaters, refrigerators, and washing machines, while the model living room will be used to display and demonstrate such appliances as vacuum cleaners, sewing machines, portable lamps, etc. The living room will also be used as a waiting room for the public, and a rest room for ladies is provided, opening off this living room. These model rooms open directly off the main display floor. At the rear of the main floor is a mezzanine floor, approximately 58 ft. by 18 ft., overlooking the main display floor. Beneath the mezzanine floor on the main floor is located a shipping and receiving room,

with freight elevator operating between all floors of the building, in the northwest corner of same. Also underneath the mezzanine is located telephone and inquiry desk, cashier's cage and merchandise counter for the sale of lamps, small appliances, etc. The mezzanine floor will be used for merchandise office space and additional display room. The top floor is devoted entirely to general office space, providing a main office approximately 52 ft. by 45 ft., on the northeast section of the building. A corridor 8 ft. wide is provided on both sides of this main office space, with a counter between the office space and the corridor on one side, and a railing on the opposite side of this passageway. Facing on Wyandotte Street are located a suite of offices consisting of Manager's office, Assistant Manager's office and Board Room. Along the west wall are located Engineering Office, Ladies' Rest Room and Toilet, Men's Locker Room and Toilet and Elevator Lobbey. Three fireproof vaults are provided, one in the basement and one on each of the other floors. The building is steam-heated throughout, and the furnace room is located in a sub-basement underneath the rear court yard. This provides a simple and efficient method of obtaining coal supply and getting rid of ashes besides keeping the dust and dirt of the furnace room out of the building proper. The basement is devoted almost entirely to storage of merchandise stock with the exception

Office and Sales Staff, Walkerville System.

of a small portion taken up by the vault, toilets and repair room for the service department in which all classes of appliances are repaired. For freight handling purposes, the building is equipped with a 3,000 lb. electrically operated Otis-Fensom elevator.

The electric wiring in the building has been installed with the idea of providing full and ample lighting and convenience outlets of all classes wherever required. There are a total of 339 outlets in the building, and provision has been made for the operation of four electric ranges at one time, together with a large number of other small appliances on the main floor. The show windows are lighted by means of X-ray Window Reflectors, while on the main floor four-in-one semi-indirect units have been provided. In the other office spaces, Brascolite semi-indirect units are used.

The building complete cost approximately $71,000.00, and has been financed entirely out of accrued surplus on operation. It provides sufficient space for expansion for a number of years to come, and is one of the recent additions to the many beautiful Walkerville Public Buildings.

The building was designed and constructed under the supervision of the Walkerville Hydro staff. All construction work, except electric wiring, was under contract, under the direction of the Commission's staff. The personnel of the Walkerville Commission at the present time is Mr. J. M. Whiteside, Chairman, Mr. W. R. Woollatt, Commissioner, and Mr. C. J. Stodgell, Mayor. Mr. M. J. McHenry is Manager and Secretary for the Commission, while Mr. D. B. McColl is Assistant Manager and Accountant.

* * *

Giving Service on Electrical Appliances

ONE of the factors effecting a retarding influence on increased sales and use of electrical appliances of all kinds is the difficulty the user has in getting service. An iron, washing machine, vacuum cleaner, toaster, out of use is more than just a total loss to the owner. Disuse does not help to make the use of electrical appliances a habit.

Automobiles have increased in public favor to such an extent because their constant use makes others desirous of having them. The same thing applies to electrical appliances.

When Mrs. Jones calls on her neighbor and hears about how wonderfully the washing machine works, she is likely to want one also. While on the other hand if she is told that the machine is out of order this is an influence which counteracts much of the constructive advertising and selling efforts of manufacturers and dealers.

In a survey made in Brooklyn, it was discovered that seven out of ten electrical appliances owned, were not

being used. In every home there is an iron cord that needs replacing—an attachment plug that is cracked—a loose connection here or there. All these are small matters, BUT—they keep the appliances out of use as thoroughly as if the trouble were far more serious.

What is the reason for this?

Lack of willingness of retailers of appliances to care for service work. The owner does not know to whom to go. Slight repairs to a cord often means a delay of several days.

There is practically nothing in the way of servicing the usual electric household appliances that cannot be cared for easily, and it is going to remain for the progressive retailer to capitalize on this work.

Profit in Servicing

Users of appliances will be more than pleased to hear from the electrical dealer who announces that he is ready to handle service work promptly, who will guarantee to keep the appliances he sells in operating condition.

Such a dealer can capitalize as this makes friends rapidly, and he is in the best possible position to sell more appliances.

Suppose a user calls up about some difficulty with the washing machine. This gives him the opportunity of gaining admittance to the home—straightening out the trouble, talking about other electrical appliances, and possibly making sales.

Arrangements can be made to carry a supply of small articles such as fuses, and make a sale right then and there, or an electric waffle iron may be introduced, or an electric ironer, toaster, portable lamp, fan, or other articles. In fact, a sale can be made more easily in the home than in your store. And the dealer has the additional advantage of having been requested to call. If there is something new that the dealer is handling he can introduce it when making service calls.

If every retailer made it a point to be sure that all appliances sold, were always in operating condition, he would increase his own business because this would encourage others to buy, and—appliances used regularly wear out and make room for further sales.

Appliances brought into the store should be cared for promptly and in business-like manner. When the housewife counts on having the laundress in on a certain day—she is badly inconvenienced if the iron which was to be returned is delayed. Vacuum cleaners are needed regularly, yet in one case that I know of a retailer kept a cleaner (sent for a cord repair) three weeks. There is usually no reason for such neglect of the service end of the appliance retailing business.

There can never be the proper steadily increased use of electrical appliances until this fact is recognized, and steps taken to provide this service which the public is so anxious to have. The purchaser has a right to expect satisfactory operation, and it is to the benefit of all interested in the selling of appliances, that satisfactory operation is insured.

Many will say that users often complain when there is practically nothing the matter. This is true of new users of most any product. Automobile

dealers, after selling a car to a person not having had one previously, are often called out the next morning and told that the old thing won't start. Sometimes they find that the new owner has forgotten to snap on the ignition switch—or that he is out of gasoline. At any rate the difficulty is invariably very easily remedied.

If every retailer kept a record of purchases of that class of equipment that may need attention, he could gain considerable good-will by calling on these owners several times during the first two or three months. This service would not be forgotten. It would be talked about and result in unsolicited purchases.

How the Manufacturers Can Help

It is needless to say that cheap appliances made to sell on price only cannot be serviced profitably for this reason. First, because the low price reduces the profit and, second—because the poor cord used, the cheap attachment plug, the poor assembly and material are bound to give the user trouble too frequently.

Manufacturers should use the best grade of conductor cord and all connections to the attachment plug, and the appliance should be thoroughly made. Poor cord kinks, loses its flexibility, open circuits or short circuits, and causes the user no end of trouble.

Portable type appliances should be fitted with good stout attachment plug caps, since during their use they are often pulled accidentally, with the result that pieces chip off when they strike the floor.

For Good of All

Maker, jobber, retailer and salesman all derive benefit through the making of electrical appliances more useful and more satisfactory. This keeps them off the out-of-the-way shelves—keeps them handy for every day or every week's use. Any comments reflecting on the unsatisfactory use of an electrical appliance should be challenged, investigated and something done to counteract such influence.

Through the retailer giving service in a bigger way, such incidents will come to light and such opportunities should be welcomed, because they can be turned to advantage more often than not. There is nothing that warrants a fellow patting himself on the back more heartily than to convert a dissatisfied user into a booster—and then on top of that sell him something more.

In other words, service work can be made the means of enlarging the retailers' business.

The Electrical Dealer and Contractor, October, 1922.

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Niagara Hydro Lines Loaded to Capacity

Owing to the rapid increase in the power loads on the Niagara System, the Hydro-Electric Power Commission of Ontario has found it necessary to notify the municipalities and customers supplied from that system, that their power demands must not ceed their present demands until the installation of the fourth generator unit has been completed in the Queenston plant.

The work of completing the installation of the fourth unit is being rushed night and day. It is expected that this unit will be ready for service on or about December 1, and, barring accident, the Commission hopes to have sufficient power to supply the requirements of the system during the peak load period of the winter months.

The amount of power generated and purchased by the Commission at Niagara is now in excess of 525,000 horsepower, approximately 183,000 horsepower, of which is being supplied by the three generator units installed in the Queenston Generating Station.

There has been an increase in the amount of power supplied on the Niagara system of over 100,000 horsepower since December, 1921.

THE HYDRO LAMP

THE HOUSE ORGAN

All the samples of the November issue of this bright little bulletin are gone, and we have received subscriptions suffiicient to make the issue a success.

Many favorable comments have been received on the usefulness of this organ, and while some criticisms were forthcoming, the loudest critics are now loudest in their praise of our first effort.

We want every town to distribute these to every customer and we also want this bulletin to outshine the wonderful Hydro Lamp—the bulb—so invite your constructive ideas on improvement.

If you are not now a distributor, get in on this big idea.

HOW DO YOU LIKE OUR XMAS NUMBER?

Wash and Washers

By R. K. HALL

Buying an electric washing machine would seem, at first blush, to be a comparatively simple matter, involving none of the embarrassing complications that go with the purchase of, say, a herd of elephants or a farm in Ireland. Pick out the machine that seems the sturdiest and most efficient in operation, you would suggest, pay for it, and have it sent up to the house. That should be the end of the business.

It should be. But it isn't. In fact, it isn't even the beginning.

Having decided to acquire an electric washer, I began some weeks ago to visit agencies and to inquire into the merits of the different makes. And it was here that I struck the first snag. Every dealer proved logically and conclusively that his washer was the best, outdistancing all others by six or seven laps.

At this juncture, the agent for the Snow Drift offered to send up his machine on approval and thus prove his contention. With a sense of deep relief I accepted.

In the meantime, however, the man who handled the Twentieth Century had persuaded my wife to let him install that machine on trial. The two washers arrived within half an hour of each other.

Without loss of time we tried them both out, using the grimiest clothes we could lay hands on. As a result, I voted for the Snow Drift, while my wife went into raptures over the Twentieth Century. Three hours of comparative argument, terminating somewhere around midnight, did nothing to shake our first judgments. But the next day I underwent an abrupt change of heart when I discovered that a large hole had made its appearance in the back of a new and favorite shirt. I at once 'phoned the Snow Drift agent, asking him to remove his contrivance immediately.

The Twentieth Century now became our unanimous choice—until my wife found a baby stocking that had emerged from the suds in almost the identical state of dirtiness that it had gone in. That settled its fate. Inside of ten minutes I 'phoned the agent to take it away forthwith.

In spite of our discouraging experiences, the desire to own an electric washer had not dampened to any extent. After some deliberation, we arranged to have the Speedy sent up for a trial, certain that by the time it came both the Twentieth Century and the Snow Drift would have been taken away.

That was where we blundered badly. Each of the other two agents 'phoned shortly afterwards to say that he preferred not to remove his machine for a week or so, but would send a demonstrator, who would give us a better idea of the capabilities and superiorities of his particular machine. When the Speedy was carried in, we had to move the other two washers to make room for it.

Undoubtedly the Speedy washed clean. It did more than that. In

addition to removing every speck of dirt from its contents, it picked off every button with uncanny thoroughness. It took a week to equip that particular wash with its full quota of fasteners. We notified the company that a speedy removal would greatly accommodate us.

In the course of a day or two, the Snow Drift demonstrator arrived. Although we were short of clothes for a demonstration, we borrowed a tubful from the people across the road. In ten minutes the man proved that the torn shirt was my fault and not the machine's, and induced us to give the washer a further trial. Hard on his heels came the Twentieth Century man, who demonstrated conclusively that mismanagement alone had been responsible for the uncleaned baby sock. He too pledged us to a further test.

And now, inopportunely, the Hercules agent appeared on the scene. Foolishly I had given him my name and address when I examined the washer at the Exhibition. He wanted to deliver a Hercules on approval. We told him we already had three in the cellar and couldn't get rid of them, at which he waved his hand airily and observed:

"Push 'em to one side and try ours anyway. Once you've washed with it, you'll never look at the others again."

The fellow laid some kind of enchantment on us. He went away, and two days later a Hercules washer was unloaded at our door. It was now impossible to move about in the laundry without barking a shin or an elbow against one of the four machines.

My wife and I spent all our spare time in testing washers and making comparisons. At first we were badly hampered in our researches by a lack of material to experiment with. Although we used everything washable from bath mats to potato sacks, we soon ran out of stuff. We invited all of our nearby friends to send in their wash, and, having exhausted that, went farther afield. Twice I toted a bundle halfway across the city from my mother-in-law's, and finally I was obliged to visit a distant cousin out in Weston, of whom I had long lost track.

Generally we tried out the machines singly, but on several occasions we checked up on their respective performances by running them tandem or all four at once, a couple of two-way plugs making this possible. Demonstrators came and went so frequently the neighbors began to think we had started a boarding-house.

And that is the way things stand at present. The four washers are still with us, the demonstrators insisting that we have not given them a thorough trial. In the meantime, we have seen a new machine—the Cascade—that has caught our fancy, but we hesitate to involve ourselves any further.

If anyone can offer us any constructive advice—or, better still, a hamper of dirty clothes—we shall accept either or both with genuine gratitude.

—The Toronto Star Weekly.
October 7, 1922.

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee

The meeting was called to order at the office of the Hydro-Electric Power Commission of Ontario, at 2.15 p.m., on November 9th, 1922.

Those present were, Messrs. M. J. McHenry, President, O. H. Scott, W. E. Reesor, P. B. Yates, A. T. Hicks, H. F. Shearer, T. C. James, G. J. Mickler and S. R. A. Clement, Secretary.

It was moved by Mr. Yates and seconded by Mr. Hicks:

That the minutes of the last Executive meeting as published be taken as read and approved.

CARRIED.

The meeting was called for the purpose of approving of plans for the Convention of the Association to be held at Toronto, on January 25th and 26th, 1923.

A letter from the Secretary-Treasurer of the Canadian Section of the American Water Works Association was read. It asked that the Executive consider the proposal of holding joint sessions with that Association during the Winter Convention.

Mr. Scott presented a report from the Papers Committee suggesting subjects for papers and discussions for the Convention.

It was moved by Mr. Scott and seconded by Mr. Shearer:

That the program of the Convention be as follows:—

Thursday afternoon:

A paper on Merchandising by Mr. A. W. Ramsdell, of the Burroughs Adding Machine Co., Windsor, with discussion.

A discussion on Hydro Shops.

Friday Morning:

A paper on the Use of Electric Power by Waterworks Systems, by a member of the American Water Works Association, with discussion.

A discussion on grounding of secondaries to water pipes.

Friday Afternoon:

A paper on Measurement of Loads on Service Transformers, by Mr. C. E. Schwenger, Toronto Hydro System, with discussion.

A paper on primary cut-outs for service on 2,000 and 4,000 volt circuits, by Mr. W. B. Buchanan, of H. E.P.C. of Ontario Laboratories, with discussion.

CARRIED.

Mr. Yates reported on behalf of the Convention Committee, presenting correspondence from Toronto Hotels, regarding Convention facilities.

Moved by Mr. Yates and seconded by Mr. Scott.

That the Prince George Hotel be made Hotel Headquarters for the Convention, the Hotel to provide a Convention room at a rental and serve the Convention dinner at 6 p.m. sharp, at $2.00 per person.

CARRIED.

Moved by Mr. Shearer and seconded by Mr. Reesor:

That Sir Adam Beck be asked to address the Association at its Convention dinner.

CARRIED.

Mr. Mickler, Treasurer, presented a report of receipts and expenditures

since January 1, 1922. This showed a balance on hand of $1,119.16.

Moved by Mr. Shearer and seconded by Mr. Hicks:

That the Treasurer's report be received.

CARRIED.

The meeting adjourned at 3.45 p.m.

* * *

Nominations for Officers for 1923

*These names to appear on the election ballot.

PRESIDENT

*A. T. Hicks, *M. J. McHenry, R. H. Martindale, O. M. Perry, W. E. Reesor, E. V. Buchanan, H. H. Couzens.

VICE-PRESIDENT

*O. M. Perry, A. T. Hicks, E. V. Buchanan, *J. E. B. Phelps, V. S. McIntyre, P. B. Yates, R. H. Staford, J. J. Heeg, R. H. Martindale, H. F. Shearer, W. R. Catton, R. Elliot, J. G. Archibald, E. J. Stapleton, J. R. McLinden, C. R. Cole, J. E. Teckoe, H. H. Couzens, R. H. Starr.

SECRETARY.

*S. R. A. Clement.

TREASURER.

*Geo. J. Mickler, *D. J. McAuley.

DIRECTORS AT LARGE.

*O. H. Scott, *P. B. Yates, *H. H. Couzens, *E. V. Buchanan, *V. S. McIntyre, *E. I. Sifton, E. J. Stapleton, M. J. McHenry, R. H. Starr, J. E. Brown, H. F. Shearer, E. H. Caughell, J. A. Foerster, V. B. Coleman, E. M. Ashworth, J. G. Archibald, J. J. Heeg, O. M. Perry, W. E. Reesor, J. W. Bayliss, C. R. Cole, A. W. J. Stewart, F. C. Adsett, H. O. Fisk, W. R. Catton, R. H. Staford, J. E. Skidmore, J. E. B. Phelps, Jno. Taylor, R. H. Myers, G. A. Currie, Thomas Boon, J. G. Jackson, R. H. Martindale, R. Elliot, L. G. McNeice.

DISTRICT DIRECTORS

Niagara District—

V. S. McIntyre, *J. G. Archibald, *J. J. Heeg, E. I. Sifton, W. R. Catton, P. B. Yates, A. B. Scott, J. G. Jackson, H. F. Shearer, E. V. Buchanan, R. Elliot, H. G. Hall.

Georgian Bay District—

*E. J. Stapleton, *J. R. McLinden, *W. H. Gurney, *J. A. Foerster, *A. Martyn.

Central District—

O. H. Scott, *W. E. Reesor, *G. E. Chase, *C. A. Walters, C. C. Folger.

Eastern District—

No nominations.

Northern District—

*S. A. Saylor.

ASSOCIATION OF MUNICIPAL ELECTRICAL UTILITIES

The next Convention will be held at the Prince George Hotel, Toronto, on January 25th and 26th, 1923

BE SURE to COME

The Oscillograph and Some of Its Practical Applications

By PERRY A. BORDEN

Assistant Laboratory Engineer, H.E.P.C. of Ontario

WHILE the oscilligraph is essentially a piece of laboratory equipment, it does not follow that its use is confined to the solution of laboratory problems. On the contrary there is hardly an application of electrical energy, but the efficiency of that application would be or has been improved by the use of the oscilligraph. The testing engineer, even with the most complete equipment of indicating instruments, would in many cases be forced to grope his way, as it were, in the dark if the oscillograph were not available; and many problems which have long baffled electrical men with misleading results and contradictory conclusions have been easily and simply solved upon the application of oscillographic methods. While, of course, this instrument finds its greatest application in alternating current work, it may be said that it is helpful in any place where an electric current or voltage changes its value; and there are many direct current conditions where its use has proved invaluable. Whether it be in the shop of the designer, in the central station or on the premises of the power consumer, the oscilligraph finds uses limited only by the ingenuity of the user.

It is unfortunate that the oscillograph has been burdened with a rather ponderous name; for that, coupled with its complex appearance, when equipped with its full complement of accessories, naturally leads to the impression that it is a most complicated apparatus, comparable only with the Jacquard loom, the linotype or the printing telegraph. In fact, the oscilligraph is one of the simplest of all electrical instruments, and operates upon a principle with which the electrical "schoolboy" is perfectly conversant. If we imagine a direct current ammeter or voltmeter, having

its parts so light as to respond to every variation of current and make a record of that variation, we have in substance the oscillograph.

While there are a number of different operating principles used in oscillographs, that which is by far the best known is the "Blondel" type, developed by Mr. M. A. Blondel, to whom belongs the credit of working out and describing in considerable detail the principles underlying their construction. The principle is that of the D'Arsonval galvanometer, in which we have a powerful magnetic field, and in that field a loop which carries the current to be investigated. This will be understood by reference to Fig. 1, which shows the general arrangement of the elementary parts of a well-known type. In a narrow gap between the poles N, S, of a powerful magnet are stretched two parallel conductors s, s, formed by bending a very thin strip of silver alloy back on itself over a small ivory pulley P. A spring, not shown in the figure serves to keep a uniform tension on the strips, and a guide-piece, similar to the bridge on a violin, limits the length of the free portion to that part actually in the magnetic field. A small mirror M, bridges across the two strips, but does not electrically connect them. The effect of passing a current through such a "vibrator" is to cause one of the strips to advance while the other recedes, and the mirror is turned about a vertical axis.

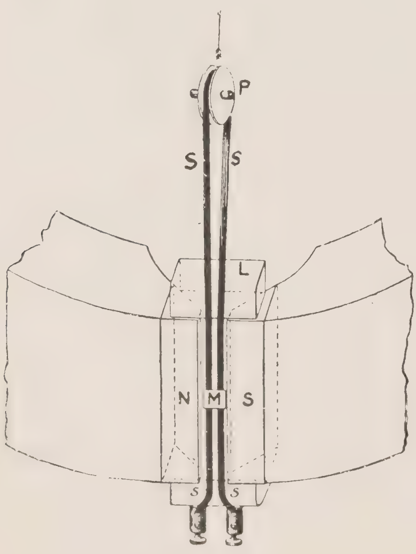

Figure 1. Diagram illustrating principle of operation.

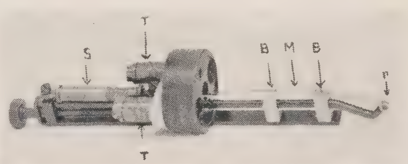

Figure 2. Complete vibrator.

A complete vibrator is shown in Fig. 2. Here is seen the strip passing over the bridges B, B, and around the pulley to its terminal T, T. Tension is maintained by a helical spring in the small cylinder S, attached to the rod which carries the ivory pulley. This tension may be adjusted by means of the knurled screw at the top of the vibrator frame. The mirror, M, is seen midway between the bridges. The actual dimensions of the strip are .007 in. wide, by .00075 in. thick. The mirror is of silvered glass, the size of a pin-head. The electrical resistance of the vibrator circuit is about one ohm, and its normal operating current in the neighborhood of one-tenth of an ampere. In use it is

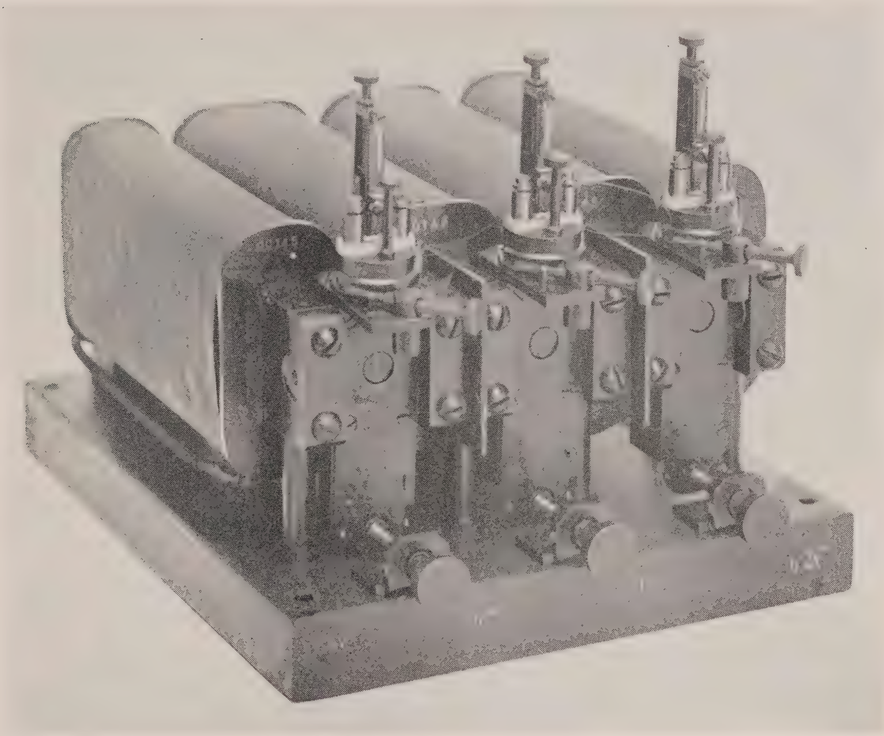

Figure 3. Unit of magnets and vibrators.

generally protected by a gold-leaf fuse, having a resistance of approximately seven ohms.

The adaptation of the vibrator to currents or voltages beyond the capacity of the strip is accomplished in the same way as in direct current instruments, viz:—by shunting for large currents and placing in series with a suitable resistance for high voltages. Care, must of course, be taken to avoid trouble due to possible inductive effects of these external resistances; but on circuits of commercial frequencies, this is not a very difficult matter. The whole vibrating part, including the little mirror, is immersed in a suitably proportioned damping fluid, contained in a cell clamped between the poles of a powerful electromagnet. The cell has a small glass window in the side so that a beam of light may be projected upon the mirror. The one magnetic structure is made to house several vibrators,— usually three,— so that three distinct electrical phenomena may be examined simultaneously. The completed unit of magnets and vibrators is known as the galvanometer. It is shown in Fig. 3. The four massive magnetizing coils are seen at the rear. The six small binding posts near the front are the terminals of the vibrators; and the windows are distinctly seen in the fronts

of the cells. Close behind these windows, in the narrow gaps of the magnets, lie the vibrator strips, each carrying its mirror.

While, technically, the galvanometer constitutes the oscillograph, considerable accessory apparatus is necessary to render it usable. The most important requisite is, of course, the light source. This is usually an arc lamp supplied with direct current, and arranged with a train of lenses to direct its light upon the small mirrors, and afterwards to focus it as a point on a photographic surface or viewing screen. This beam of light serves as a pointer to the galvanometer, and emerges from the vibrator cell carrying all the vibrations which may have been imposed upon it by the mirror, due to currents flowing in the strip, and thus furnishes us with a pencil with which a record of the current changes may be written on a sensitized film or projected on a screen. As the mirror vibrates due to an alternating current flowing in the strips, the point of light is widened out to a band, and would appear upon the screen as a straight line. If, however, the screen be made to travel uniformly in a direction perpendicular to this line, the path of the light spot over the surface will represent the wave of the current in the vibrator; and if this current follows a harmonic law, the spot will trace a sine wave.

In making photographic records with the oscilligraph, this screen takes the form of a sensitized film, which, wrapped about a drum, is caused to travel in front of a slit through which passes the vibrating spot of light. In this way there is traced upon the film an exact representation of the movement of the vibrator strips, and hence a picture of the wave form of the current carried by them. This film, being developed and printed in the ordinary way, provides a perfect graphic record of the variation of the current through its cycle.

As it is frequently desirable to view the wave without photographing it, there is provided a visualizing device, which makes it possible to examine a wave in the course of a test, and not waste time and photographic material making exposures of conditions which have no significance. This is accomplished by interposing in the path of the light beam an oscillating mirror, driven by a small synchronous motor, so as to deflect the beam on to a translucent screen, and at the same time to give it a motion perpendicular to that imposed upon it by the vibrator mirror. The combination of the two motions gives us upon the screen, a trace of the wave of the current in the vibrator; and the light being momentarily cut off by a shutter on the synchronous motor shaft during the return swing of the oscillating mirror, we see on the viewing screen a perfect picture of the wave form of the current. With a steady current and where accuracy is not highly important, it is a simple matter to trace the wave directly on a sheet of thin paper, and thus do away with the refinement of making a photographic record. When a condition is obtained of which a photograph is desired, this is obtained by the simple expedient of throwing the synchronous mirror out of the path of the light and exposing the film for one revolu-

tion of the drum. While the standard film used in the laboratories of the Hydro-Electric Power Commission is about one foot long, there is provided a special drum whereby it is possible to obtain protracted exposures as long as six feet; and there has been developed by the Bureau of Standards in Washington a camera whereby the oscillograph may be made to produce continuous records as long as forty feet.

While the oscillograph in its ordinary form requires great care in its manipulation to assure proper sequence of events necessary to obtain photographic records of occurrences in electrical circuits, this being particularly true in the case of transient conditions, such as those introduced by switching phenomena, there have been developed automatic devices which practically eliminate the personal element, and make possible perfect oscillograms under the most exacting conditions. One manufacturer has recently carried the development of the instrument to such a degree of refinement that he claims it can be connected into a circuit for investigating the phenomena attendant upon the operation of an oil switch, and left unattended for months; and yet that upon occurrence of the condition which it is desired to record, the same relay that operates the breaker will start the oscillograph with such promtness that the apparatus will be recording before the switch contacts have separated.

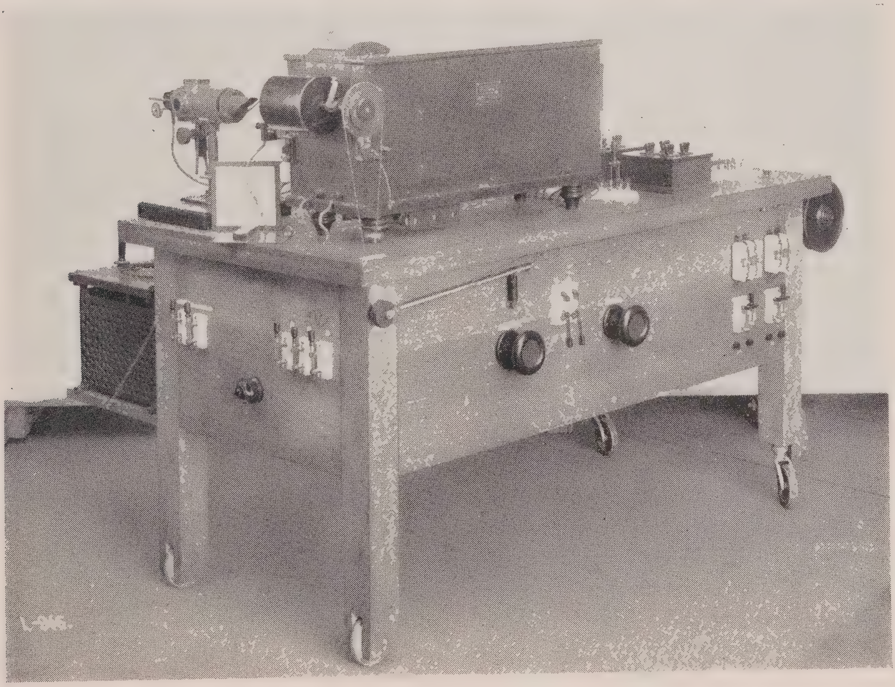

Figure 4. Oscillograph with specially wired table.

The complete oscillograph, together with the specially wired table used in the laboratories is shown in Figure 4. The galvanometer, with the attendant optical equipment are contained in the boxlike structure upon the table. The Arc which applies the light beam is seen at the left of the picture, while the various switches and rheostats constitute the controls for operating the apparatus. The table, being portable, may be taken to any part of the Laboratory, where tests are in progress. A smaller and more compact table, similarly equipped with control devices, and so arranged that it may be completely dismantled for packing is provided, together with a shipping case, for use when the oscillograph is to be sent to stations or other points outside the Laboratory. The whole oscillograph with its accessories may be quickly packed in specially padded trunks for shipping, and reassembled at the point of test in a very short time.

To give some idea of the variety of uses to which the instrument may be put, there are shown a number of oscillographic records, which have been taken from the Laboratory files. These are illustrated in Figure 5. Following are brief explanations of the conditions represented by the several oscillograms:—

No. 1. This represents an alternating voltage such as would be found on any ordinary circuit.

No. 2. Here are shown two waves, the smooth one, approaching in form the true "sine wave," being the voltage of an alternating current supply, and the other its distorted form after being transformed by a "freak" system of transformer connections.

No. 3. This illustrates more voltages and currents in a set-up similar to that in the preceding film.

No. 4. In this film are shown the results of endeavoring to triple the frequency of an alternating current system by means of a transformer arrangement. The supply voltage and the line current of 25 cycles per second, and the secondary voltage of 75 cycles are shown.

No. 5. The rush of current upon first switching a bank of transformers in on the system is shown here; and it will be noted that the amount of "overshoot" is not the same in the three lines.

No. 6. Here is well represented the flow of current in a short circuit on an electric railway system. The low frequency wave at the bottom of the film shows on a very small scale the voltage supplied to the rotary converter feeding the system. The commutator voltage is shown by the rippled line running along the top of the film. The zero of this voltage is the same as that of the supply voltage, but the scale is much larger. It will be seen that there is a triple frequency component of the original voltage remaining at the direct current end of the machine. A close examination of the original film shows a still higher frequency superimposed upon this ripple, this being due to the commutator bars of the rotary converter. This test was made by throwing the circuit breaker in on the short circuited line, and allowing it to open automatically. The growth of the current is plainly shown; it having reached an almost steady value when

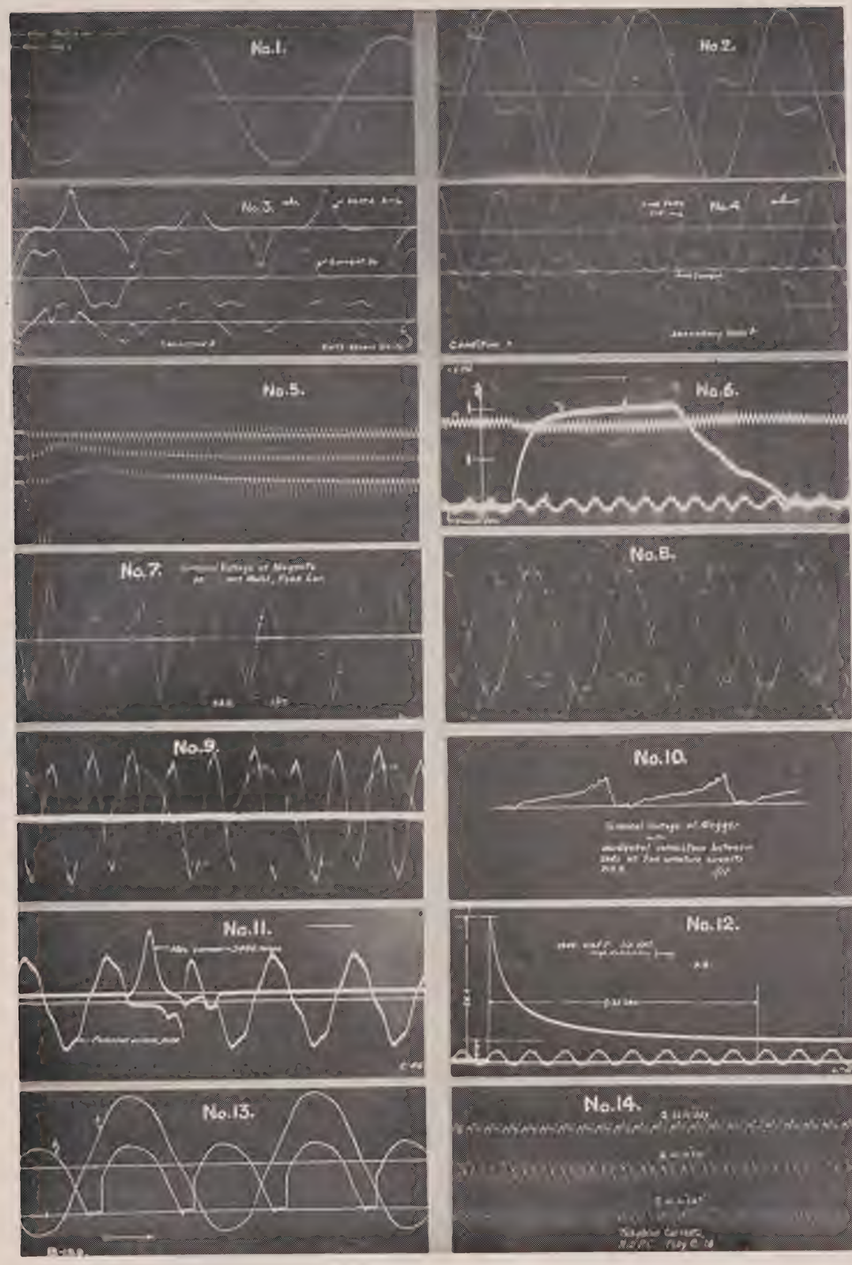

Figure 5. Oscillograph records.

the breaker operated after the lapse of seven cycles of the supply voltage. Upon the opening of the breaker, the decline of the current is noted, as it returns tó its zero value, the process of extinguishing the arc occupying a period of a little over four cycles. It will also be seen that during the time of the short circuit, the D.C. voltage was slightly pulled down, returning to its normal value with the cessation of the current.

No 7. This illustrates the terminal voltage of a Ford magneto. Owing to the peculiar shape of the field magnets, a very peaked wave is obtained. The clean-cut waves are those occurring between ignition periods, while the serrated portions of the curve show how the voltage is disturbed by the action of the vibrator and coil as a load on the generator.

No. 8. The waves shown on this film are the terminal voltage, the voltage of one coil, and the star voltage of an old type of generator. "Tooth ripples" are very evident. In modern types of machines these ripples are practically eliminated.

No. 9. The terminal voltage of a generator is here shown, together with the triple frequency existing between ground and the star point of the winding.

No. 10. The usefulness of the oscillograph in repair work is suggested by this film. The generator in a Megger insulation testing set should deliver a direct current with a slight ripple. The wave shown was obtained from a Megger having a defective armature.

No. 11. This film was taken to examine conditions attendant upon the operation of a 2,400 volt fuse. Two fuses were placed in series on opposite sides of the circuit, and a breaker closed between them. The change of voltage and the rush of current are well shown. It will be noted that this particular type ruptured the current in one cycle.

No. 12. This interesting film shows the rush of current through a tungsten lamp, upon closing the circuit. The test was made with direct current; but a 25 cycle timing wave is added. It will be noted that the initial rush of current is nearly eighty times the normal value. This, of course, is due to the comparatively low resistance of the metal filament when cold. This is characteristic of all metal filament lamps, but the relative value of the initial current varies considerably with different types and ratings. The lamp upon which this test was made was of the gas-filled variety, rated at 1,000 watts, 115 volts.

No. 13. Here are shown the applied and derived voltages of a mechanical rectifier, of the commutating type. An oscillographic study of the rectifier under different conditions of operation is most interesting; and such tests have brought to light some surprising and important facts in the rectification of alternating currents.

No. 14. By connecting the oscillograph to the circuits of a telephone, it is a simple matter to observe and photograph voice waves, as represented by the currents in the line. This current shows the wave corresponding to three pronunciations of the letter "a." To the radio "fan" the question of the possibility of ob-

taining records of the carrier waves used in wireless communication is naturally suggested. It may be said that the ordinary form of oscilligraph is quite unsuited to this type of work. The abnormally high frequencies of these currents make it highly improbable that they could be made to pass through the loop which constitutes the vibrating element; and even if they could be made to follow the strip, the inertia of the moving part would prevent its vibrating with sufficient frequency to obtain a record of the wave. In general, it may be said that any frequency not above the range of the human ear may be successfully recorded on the oscillograph, but that for higher frequencies it will be necessary to resort to some means wherein the moving part is devoid of inductance and of inertia.

The oscillograms which have been described above are but a few of the hundreds which have been made by the Commission's Laboratories; but they will serve to give an idea of the unlimited variety of applications of the instrument in electrical work. Conditions which would otherwise baffle the investigator may by means of the oscillograph be graphically recorded in a form which is easily interpreted, and may be studied at leisure, and frequently compared with similar records which have been elsewhere obtained. Thus it will be seen that by means of the oscilligraph, there is opened up a whole new field of information for the investigator who desires to get at the causes of the multiplicity of occurrences which may take place in the electric circuit. What the microscope is to the biologist, the telescope to the astronomer, or the spectroscope to the physicist, such is the oscillograph to the electrical engineer; and with this oracle at his command, he may well say with the much advertised owner of Brittanica "Now, ask me anything."

* * *

Hydro News Items

Central Ontario System

The Ornamental street lighting in the business section of Trenton is completed on the west side of the river, and was put into operation for the first time on November 3rd.

* * *

A line extension to serve consumers on Stanley St., Bloomfield, has been erected.

* * *

The replacement of the old poles in the business section of Main St., Picton, has been practically completed. This construction clears up some dangerous transformer poles.

* * *

A strong canvassing committee is working in Haldimand Township following a public meeting at Grafon, on October 26th.

* * *

Construction of a rural line to serve Cataraqui Village, Kingston Township, is under way. It is probable that this system will be greatly extended next year.

* * *

Eugenia System

The reconstruction of the Distribution System in the Hamlet of Eugenia was commenced on November 9th, 1922. This system is to be operated in connection with the Flesherton System, the consumers having signed standard rural contracts on the basis of rural district rates.

The village will be placed in operation under the new conditions on December 1st.

* * *

The Municipality of Hanover is contemplating the installation of a new Water Works System, taking water from Rhul Lake, and proposes using electric power for the purpose of operating the pumping units.

* * *

Niagara System

The new sub-station at Petrolia municipal waterworks pumping station is being put into operation about the end of November. This station is located near Perch at the south end of Lake Huron. The plant has been operated for the past twenty-five or thirty years by a steam plant, which is now nearly worn out. The better of the two engines will be retained as a standby service.

* * *

Arrangements have recently been made to increase the transformer capacity at various towns on the Essex County System; among these are Essex, Amherstburg and Leamington.

* * *

The Commission's new outdoor type sub-station at Grimsby has been put into service recently. This sta-

tion will supply a number of power consumers in the district, together with the rural power district now being constructed in this section.

* * *

The Commission has put into operation recently the new 110,000 volt outdoor type station at the east end of Hamilton. This is the first outdoor type station for 110,000 volts constructed by the Commission. The capacity of the station at the present time is 15,000 kilowatts, and the Hamilton lines have been arranged so that the entire load of the Hamilton Hydro-Electric System can be handled from the east end station if necessary.

* * *

The Toronto Hydro-Electric System has recently taken over the operation of the distribution system of the Toronto & Niagara Power Company, and arrangements will be made to gradually combine the two Systems. Arrangements may be made to have York Township Hydro-Electric System and Scarboro Township Hydro-Electric System take over that part of the Toronto & Niagara Power Company's lines located outside of the city limits.

* * *

Rideau System

The manufacturers in Perth, Smith's Falls and Carleton Place have formed themselves into an Association to investigate the possibility of getting a reduction in power costs. Several meetings were held, and the situation has been discussed. The Commission's representatives were present at some of these meetings to give such information in connection with the finances of the system as is known at present. A committee of the Association visited the Commission to present their problem to it.

* * *

Owing to the increased demands upon the system, there was some consideration given to the adequacy of the water flow at the High Falls Plant. In order that there would be no risk run in this connection, the plant at Carlton Place was started, and will be operated until it is definitely determined that the water storage is ample to carry on through the winter season.

* * *

The Grenville Crushed Rock Company has closed down for the winter season. During the latter few months it has been taking its full amount of power initially contracted for. There is some possibility of the Company increasing this load next year.

* * *

Severn System

Arrangements are being made to install three 300 kv-a. transformers now in Collingwood, at the Penetang Substation. This change is required on account of rapid increase in load in this municipality.

* * *

The Municipality of Beaverton has recently made a contract with the Canadian National Railways for 70 h.p. off peak load for charging a storage battery car which will operate between Beaverton and Toronto.

* * *

The municipalities of Uxbridge and Port Perry received power for the

first time on September 29th, 1922. The distribution systems have been entirely rebuilt at a considerable saving from original estimates. Both municipalities are already using power more than 50% in excess of estimates on which rates were based.

* * *

St. Lawrence System

An extension from Lancaster is being constructed to supply residents of South Lancaster on the rural basis.

* * *

Extensions are being made to the Martintown Rural District to supply additional consumers in the Hamlet of Williamstown.

* * *

An additional power load has been obtained in the Town of Alexandria, and it is expected that a further additional power load will be obtained during the coming winter.

* * *

The Eugene F. Phillips Company started production in their new mill at Brockville on the 1st of November. They are now rolling copper rod and strap copper for use in their Montreal plant.

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The A.M.E.U. Convention

This Association will hold its next Convention at the Prince George Hotel, Toronto, on January 25th and 26th, 1923. In using the hotel for Convention headquarters, it is hoped to arouse an even greater interest in the winter convention than has been shown heretofore, and at the same time tend towards smoother working of the convention and convenience for the delegates.

The preceding number of the Bulletin contains an outline of the program of papers and discussions. The subjects are of importance to all electrical utilities. The utility representatives should, therefore, make every effort to be present and attend all sessions. After the delegates have received the advance copies of the papers, they should read them carefully, and come to the Convention prepared to help in the discussion. The discussions form the most important part of any convention.

The success of any organization depends upon the support it receives from its members and also upon its officers. In the elections the members have the opportunity of stating who those officers shall be, and this is a duty that should not be neglected. The list of the nominees for the various offices is given herein. The members have therefore, an opportunity to study it and discuss the merits of various candidates among themselves. They should come to the Convention prepared to vote to give the Association an executive that will be the best available.

* * *

Early Difficulties

We have shown how as a result of the combined action of a number of municipalities, the Hydro - Electric Power Commission was formed. This was the turning point where preliminary investigations ceased and real action commenced. Corporations that had up to this time undisturbed control of the distribution of electrical power in certain sections saw that they were about to be faced by real opposition, and must if possible retain their monopolies.

We saw how Toronto was the key municipality to the whole Hydro scheme. As would be expected a very determined opposition was developed to prevent Toronto from entering into the new formed partnership. The story of the struggle in Toronto, as also of a similar contest in Hamilton is given herein. Similar battles were fought in a number of the other municipalities which were of less magnitude, but all resulted in the principle of municipal ownership being victorious. When the municipalities had shown their determination to take the electric utilities into their own hands, most companies entered into negotiations with their respective municipalities, and sold their systems to them. The Dominion Power and Transmission Company and the Toronto and Niagara Power Company, however, continued operation in their respective fields in opposition to the new municipal systems.

In Hamilton, St. Catharines, Welland and Brantford, we see subsidiary companies of the Dominion Power and Transmission Company still operating. The municipal system in each of these places shows a very healthy growth, and to be in sound financial condition. The numbers of consumers served are in each case beyond those formerly served by the companies, yet we do not hear any reports of any of these companies becoming insolvent.

Similarly in Toronto, the Toronto and Niagara Power Company continued to work with the local Hydro System as opposition, and when its system became the property of the City of Toronto recently, it was as a going concern and not as an insolvent company.

In all cases the opposition by the local Hydro Systems worked to the benefit of all consumers. When the companies found that they could not sweep back the tide of public ownership of electrical utilities, they immediately reduced their rates to a basis where they could compete with the municipal systems. In spite of all their efforts to prevent the delivery of electrical power at lower rates, people who voted against and opposed the acquiring of municipal systems have failed to raise any objection to paying smaller lighting and power bills.

History of the Hydro-Electric Power Commission

NO. 3

The Struggle for Municipal Ownership

By E. B. BIGGAR

The Situation at Hamilton

AS early as 1897, the Dominion Power and Transmission Company transmitted power from a point near DeCrew's Falls to Hamilton, 35 miles. The installation consisted of only one penstock operating two units of 3,000 h.p. in all, but it was the greatest feat in long distance transmission at that period east of the Rock Mountains and required types of machinery not hitherto used. The highest voltage then used was 10,000, but this company raised it to 20,000 volts. Water drawn from the Welland Canal at Allanburg was at first carried by a viaduct over the Beaver Dam Creek, but by a happy thought of the engineer, 800 acres of land were purchased and converted at very small expense into a storage dam containing several small lakes, some of them 40 feet deep, and the power was then obtainable with a fall of 265 feet. This gave seven units, with a total of 52,000 h.p, and made one of the most economical installations on the continent. It was this advantage which enabled the company to give attractive prices to the citizens of Hamilton, Grimsby and other places, and yet make such profits as to enable it to acquire control of the light and power services of Hamilton, Brantford, Oakville, etc., and of the system of radial electric railways centring in Hamilton, some of which have been independently started with steam power. These amalgamations were the more easily accomplished as the men in one company were shareholders in the other companies. It was alleged that the Hamilton Cataract Power Co. could generate profitably at $4.50 per h.p., and consequently it was hardly expected that the Commission could offer much advantage in prices to the citizens of Hamilton and Brantford, to which city the Hamilton Cataract Co. had also extended, obtaining a franchise for both the lighting and power service, and for the street railway and the electric line to Hamilton. The scope of this company's financial ramifications may be seen from the fact that, stage by stage, it obtained control of fourteen companies engaged in public utilities in and around the Niagara Peninsula, among which were: The Hamilton Electric Light and Power Co., The Hamilton Street Railway Co., Hamilton and Dundas Street Railway Co., Hamilton,

Grimsby and Beamsville Electric Railway Co., Brantford and Hamilton Electric Railway Co., the Western Counties Electric Co. of Brantford, the Dundas Electric Railway Co., Lincoln Electric Light & Power Co. of St. Catharines, the Welland Electrical Co. of Welland, and the Hamilton Radial Electric Railway Co., extending to Oakville and originally designed to go through to Toronto. With the mastery of public services for these cities and towns, and the monopoly of primary power at such low costs, the company could have supplied Hamilton and Brantford at unprecedentedly low rates and yet have a good surplus. Yet when the Commission came into the field, the citizens of Hamilton were paying ten cents per kilowatt hour, the commercial users fifteen cents per kilowatt hour, besides a meter charge, and the city was charged $84 per year for each arc lamp. No reduction was made till tenders were asked from the Commission, which estimated the cost of arc lamps at $43 a year. Then the company dropped the price to $47 a year, but fixed up a five-year contract with the city. Later the city asked for tenders for power for pumping and sewage, and when the Commission's tender was found to be $17.50, compared with $45 from the Company, the latter came back with an offer to supply any municipality with service at ten per cent. below the rates of the Commission, whatever those rates might be. The logic of this experience was not lost upon the citizens of Hamilton, and in 1911 it was decided by vote of the ratepayers that when the contract with the company expired the city would get its power from the Commission and own its own distribution system. The sum of $505,000 was voted for the purpose, and in the face of injunctions and other legal actions designed to thwart the new policy, the city hydro system was adopted in January, 1912. It began operations in 1913 with only five customers of all classes; now it has 19,882 customers for domestic lighting, 2,021 customers in the commercial class, and 629 customers for electric power.

* * *

Toronto's Struggle for Self Government—The Power and Lighting Problem

The situation of Paris or Verdun during the great war did not more truly determine the issue with Germany than did that of Toronto on the power problem during the formative years of the Hydro-Electric Commission. In vain would other Ontario cities have raised the cry "they shall not pass," if Toronto had surrendered to the trained hosts that knew so well how to use the public revenues to defeat public control. If Toronto had fallen, as Paris did in the first war with Germany, generations would probably have passed before the municipalities would have recovered the control of their own civic functions, and then only after wiping out the entail founded on the system of public taxation for private profit.

At the time Toronto was considering the establishment of a distribution system for electric power, the Toronto Electric Light Co. had

bought off or killed off all opposition and held a monopoly of electric lighting and power in the city. It had started business as an arc lighting company and, in its agreement with the city, undertook to lay its wires underground and not to amalgamate with any other company. It respected these conditions by absorbing the business of an incandescent lighting concern and so getting the use of the incandescent concern's overhead wires. The city, instead of stopping the violation of the agreement, allowed time to pass, during which the company extended its overhead wires. It was only in 1911 that the city brought action and not until 1916 did the case reach a decision in the Privy Council upholding Toronto's contention, but even then only in respect to those areas since annexed to the city.

When the company was organized in 1883, it had a paid-up capital of $175,000, and in 1907, after twenty-four years, had an authorized capital of $4,000,000, with a yearly income of $1,039,716 and a clear profit of $387,790. Its dividend was 8 per cent., and, allowing for the reserves which it was laying by, it was earning 13 per cent. per year. In 1889 it had secured a thirty years' contract with the city, renewable for further periods of twenty years in the event of the city not purchasing. The company had started operations with a steam plant, the cost of generating being at the time $55 to $60 per year per h.p., but about 1906 was receiving power from the Electrical Development Co. at Niagara Falls, over the lines of the Toronto and Niagara Power Co., with both of which it was affiliated by shares held in common and by interlocking directorates. The same group were in control of the Toronto Street Railway Co., as well as of the company holding franchises for the radial railways reaching east, west and north of the city. Interlocked with these was a holding company known as the Toronto Power Co., which had acquired rights, the exercise or lapse of which might have the effect of avoiding some of its obligations to the city. The Toronto Electric Light Co., besides a rapidly growing power and lighting business, had the latent influence of several hundred city shareholders numbering men in high social and business positions, loan and financial companies and philanthropic organizations. Its influence had been strong enough to defeat a by-law submitted in 1895 to establish a civic lighting plant, and an attempt made in 1897 to get fresh estimates had come to nothing. In 1900 when the report of the Toronto Board of Trade, stirred public interest another ineffective attempt was made for action by the city council. Public discussion, however, was accomplishing something, and the press on the whole was favorable to municipal operation or ownership, or both, of electrical distribution systems.

Each of these companies obtained investors who put their money in, expecting profit, so that omitting the holding company here was a system providing four stages of profit-taking, in each of which the profits would come from the consuming public. Four toll gates were erected between the people and the source of profit.

With such a combination of financial, transportation and other interests arrayed against it, and with the opposition in the Legislature seeking to embarrass the Government, it seemed a forlorn hope to establish any public service under municipal ownership. When at last the Commission was able to offer Toronto an estimated rate of $17.75 per h.p. per year, the manager of the lighting company authorized the statement that they had a rate with the Electrical Development Co., which would enable them to supply the city at $8.75 and would only require the city to pay for the power it used. In the hope of reaching an agreement for taking over the company's plant and transmission lines negotiations were started by the Government, but drifted along while preparations were being made for the transmission lines from Niagara to Toronto. The hand of the franchise holder was meantime felt in Toronto from many unexpected quarters. No doubt the affiliated interests chuckled when the Grand Trunk Railway Co., for purposes of its own, stepped in and expropriated enough land in the environs of Toronto to block the transmission line. An appeal was made to Ottawa but the Dominion Railway Commissioners upheld the railway company, thus causing months of delay, till another route of entry was found along the lake front.

Articles appeared in some of the journals friendly to the private interests warning the public of the menace to life from the untried high voltage, and to further advertise these warnings, agents went out along sections of the line from Niagara inciting the farmers and others to ask high prices for the right of way and to bring actions for damages against the city and the Commission. Adroit endeavors were made in the same papers to convince the public that if Toronto wished to own its own services a producer-gas plant would be the best source of power. The affiliated companies did not themselves act on this belief in producer gas. The Toronto and Niagara Power Co. had obtained an 80 ft. right of way from Toronto to the Falls, ample to provide not only for all transmission towers, but enough space for a double track high speed railway which would give a new connection with New York and round out the radial lines by which they would become masters of the suburban traffic with Toronto. At the Niagara end they had bought 530 acres of land along the Chippawa stream upon which they could build industries that would consolidate their production interests.

Knowing with what veneration the Imperial Privy Council upheld vested interests, it was hardly to be wondered at that the offers made by the city to take over the plant of the Toronto Electric Light Co. were rejected rather light-heartedly. The directors of that company no doubt thought they had correctly taken the measure of the city council, for they had some years before this induced the city assessor to become the general manager of the Street Railway Company. This gentleman, had been for years an alderman and for four years was Mayor during a time of controversy with the Company. No other tried

servant of the city possessed so much of the kind of information these companies wanted as he.

At a conference in 1908 between a committee of the city council and the directors of the lighting company to discuss terms of sale, it appeared to the city's representatives that the company was disposed to deal only on the basis of a capitalization of its future prospects calculated on its existing high rates. "We are not before you to offer our property for sale," jauntily declared the company's legal counsel at this conference, "rather the city is in the market as a buyer. It is impossible to make an offer when as a matter of fact the property is not for sale." He boasted of having a contract which, if not annulled by the city's purchase on the company's terms, would be perpetual, and having already 9,000 customers for power and light, they were prepared to meet the city's competition, being sure that most of their customers would remain with the company. Moreover, the company had such a good contract with the Electrical Development Co.—though he declined to disclose the figures—that they could afford to reduce the rates at once by 20 per cent. and still have a profit.

After long discussion the city offered to pay $125 per $100. The company would accept no less than $160, and the city went no further towards purchase. In 1919 the stock was quoted at about $44.

The city council had approved the provincial hydro-electric policy in 1907; legislation authorizing the city to make a contract passed in the same year, and in 1908 the council submitted a by-law to spend $2,750,000 in building a distribution plant, and the by-law was carried by a majority of 15,048 to 4,551. The first installation of the Toronto plant was sufficient for 10,000 h.p., it being understood that extensions would be made when the operation of the initial system proved a success. This success having been shown, a further issue of city debentures to the amount of $2,200,000 was made for the extensions, and since then investments in other extensions have been made.

The actual outcome of Toronto's enterprise can be studied by the accompanying graphic statistics condensed from the report of the city commission, and brought down to the end of the calendar year 1919:

In 1912 the Toronto Electric Light Co. had 19,000 customers and in 1914 these had increased to 22,000, since which date the company has ceased to publish its figures. At the end of 1911, comprising its first nine months, the municipal system had less than 4,000 customers, at the end of 1914 these had exceeded the private company, being 31,500. At the end of 1915 there were 38,834, and at the end of 1919 there were approximately 63,750. At the end of the first full year of 1912, there was a surplus of $226,199 over operating expenses and maintenance and a net surplus of $13,555 after meeting the sinking fund charges. Had the business been conducted as a joint stock company, the surplus would have permitted a dividend of 5 per cent. this year; but the principle on which the Commission carries on its trust is that when

the point is reached where surpluses are made beyond the provisions for the sinking fund the balance shall be restored by reducing the rates to the public. The surplus in 1913 was equivalent to a dividend of 7½ per cent. on the cash invested, and the city gave a service in electric light and power cheaper than any city of similar size on the continent. In the first year and a half the amount of power used was approximately 6,000 h.p., in 1919 it was about 60,000 h.p.

Before the Hydro-Electric system came into the field, the Toronto Electric Light Co. charged 8c. per Kw. hour for residences, 8c., 10c. and 12c. for commercial lighting, and 2⅔c. to 6c. for power. The rates of the Hydro System in 1914 were reduced to such a point that the average revenue obtained was 4c. for residence, 2.85c. for commercial lighting and 1.31c. to power users. These average rates being equal to $20 per h.p. per year.

The Toronto Electric Light Co. appears to have been administered efficiently during the years of its competition with the municipal system. It had all the advantages of its previous experience, and it had the specific advantage of having wired and installed the connections with all the big buildings, many of which it still retains. It has had a fair field and an equal opportunity to obtain the new business due to the city's growth. Therefore, the claim that public ownership is uneconomical and private ownership superior in efficiency has met a straight challenge here, and judgment may be rendered upon the results.

We may speculate on what would have been the effect on the whole movement for public ownership of hydro-electric power in Ontario had the monopolist group in the first few years of this century, reduced its rates to a reasonable margin. The Toronto company had itself boasted that it could afford to reduce its rates 20 per cent. and still make a profit, but it sent no peace embassy to meet its opponent. It might have given as an act of grace the reduction it afterwards had to yield to the force of competition. It is possible that had this act of grace been manifested at the right time this group would to-day have remained the benevolent despot of power supply in this part of Ontario. The historic fact is that the company did not make much use of its opportunity, but left the municipalities to put into living practice the ideals which the private company might have striven for, if not attained to.

Electrical Service in Rural Districts

THIS subject has aroused considerable interest in almost all parts of Ontario, especially in those districts adjacent to the Commission's lines. In some parts of the United States problems have come up concerning giving service in rural districts,and endeavors have been made by The State Public Service Commissions to lay down rules to govern the utilties in this work. The orders of The Oregon Public Service Commission and of the Railroad Commission of Wisconsin have been published. These are of interest when compared with the methods adopted by the Hydro-Electric Power Commission.

It is with the object of bringing out those comparisons that this article is written, dealing more especially with the relationship between the utilities and the consumers.

The Oregon Commission after investigation and hearing has issued an order,* effective October 15th, 1922, prescribing the rules and regulations to be observed by electrical utilities in the financing and construction of rural service lines. A consumer is defined as "any person or persons, firm or corporation, who shall contract to use electricity at tariff rates for a period of at least five years and be financially responsible therefor." A rural district "shall include all of the distribution system built primarily to serve 'consumers' located outside the corporate limits of cities and towns or other territory which has a character or density of population generally similar to urban conditions."

*—22 Rate Research Page 110.

It would appear that the Oregon order applies only to what we consider suburban districts and that such users are required to guarantee a revenue for at least five years. With the Hydro municipalities such districts are usually served as a part of the urban district at slightly higher rates. The twenty-year contract used by the Hydro is due to the method in which it is financed. The general method of financing utility companies being on a different basis, naturally permits a lower contract term even though the rural extensions may be carried into less populous districts.

With the exception of the cost of the meter, all costs whether primary or secondary are charged against the rural district. The utility companies are required to spend in distribution lines, four dollars for every dollar per year of guaranteed revenue. This is termed "Free Utility Extension." Any additional cost above this amount is paid by the consumers. The utility company carries the cost of all lines over public rights of way as of the rural district, while lines over private property are paid for by the consumers. After completion, all lines whether financed by the company or by the consumers, become the property of the company. Provisions are made for a separate accounting of the rural distribution so that it must be made financially independent of the

urban districts. The consumers must, therefore, either in the monthly bills or by money advanced on construction account bear the whole cost of the service. By the system of subsidizing primary rural lines by the Government of Ontario, the consumers in Hydro rural districts are relieved of some of the cost which makes extensions into sparsely settled districts possible. In that the Hydro district carries all costs excepting line on the consumer's property, he also receives the benefit of the lower rates at which the Hydro Commission can obtain money.

Early in 1920 the Railroad Commission of Wisconsin made a study of the question of rural service with the object of laying down rules such as has been done by the Oregon Commission. In its decision it lays down some very general rules, but does not go into details, the reason stated being —"The subject of electric rural extensions is so involved that the formulation of rules to cover adequately every point which may arise is practically out of the question."

It is recommended that the electric utility finance all rural extensions and charge a rate commensurate with the cost of service. But it is recognized that this method of financing is impracticable for most utilities, and therefore, permits the utility raising the necessary capital among the prospective consumers, or having the consumers pay the costs.

The order permits the utility company to file with the Commission for approval, rules governing extensions of the electric lines and service into rural territory. A number of such rules are recorded. These contain a definition of a rural district similar to that contained in the Oregon Commission order, as also in reference to ownership of the lines.

A rule covering rates is:—

"The rates for rural service shall be:—

(a) A rural charge plus

(b) The regular urban rates."

The rural charge covers the amount by which the fixed charges, energy losses and operating expenses incident to rural service exceed the corresponding item for city service. The annual rural charge is made up of "ten per cent. of the total construction cost of the extension, plus, the total transformer core losses per year computed at a rate of 1½ cents per kilowatt hour, minus, thirteen and one-half per cent. of two times that part of the annual revenue from the extension which is computed at the regular urban rates." The intent of the rate is to provide a rural charge which will take care of all the excess fixed charges and operating expenses due to the nature of the rural business, and which will, when paid, place the rural consumer on exactly the same basis as an equivalent urban consumer and make the urban rate applicable. The ten per cent. charge on construction is made up of:—

Depreciation, 4 per cent.

Taxes, 1½ per cent.

Return, 2 per cent.

Excess operating expenses, 2½ per cent.

No interest on investment is allowed because the investment is made by the consumers. A tabulation of data obtained from 25 utilities showed that

the average investment in distribution system is twice the average lighting revenue per consumer. It was considered that the average city condition would represent fairly well the average in rural districts. The usual allowance in cities is:—

Depreciation	4	per cent.
Return	8	per cent.
Taxes	1½	per cent.
	13½	per cent.

Instead of deducting 13½ per cent. of the average investment in distribution system per urban consumer, for the purpose of the rule, the deduction is 13½ per cent. of two times that part of the annual revenue from the extension which is computed at the regular urban rate.

The total annual rural charge as obtained from the foregoing is distributed among the consumers as follows:—

"Fifty per cent. of the total annual rural charge shall be apportioned equally among the consumers."

"Fifty per cent, of the total annual rural charge shall be apportioned among the consumers according to installed transformer capacity. In case two or more consumers are served from the same transformer the installed transformer capacity for each consumer shall be considered as the estimated portion installed for the requirements of each individual."

In a report* of a recent order by the Wisconsin Commission we find the following schedule of rural charges:—

*—22 Rate Research Page 9.

		per month
1	K.V.A. transformer or less	$2.00
2	K.V.A. transformer or less	2.50
2.5	K.V.A. transformer or less	2.75
3	K.V.A. transformer or less	3.00
5	K.V.A. transformer or less	4.50
7.5	K.V.A. transformer or less	6.30

In addition to the rural charge the consumer shall pay the regular rates charged for service in the adjacent community where the extension originates. This charge will include all minimum service and demand charges which are part of the urban rates.

Apart from the fact that the consumers take all responsibility for financing the rural extensions, the method of arriving at and distributing those charges is quite different from that used by the Hydro Commission. The rates used by the Hydro Commission provide for capital charges on all costs, except those paid by the Ontario Government together with a percentage of the total capital to cover the cost of upkeep on all construction, and a charge per consumer to cover the operating expense. This constitutes the service charge. The consumption rates are based on the cost of power at the point where the rural lines are served. The primary portion of the system which includes everything up to the high tension side of the transformers is distributed among the consumers on the basis of their class demands. The secondary portion which includes the transformers and protective equipment is prorated on the basis of the costs of the different classes of service.

With the exception of these few differences in the method of handling details we find the three Commissions endeavoring by very much the same methods to take care of a new and difficult class of business. Although one is publicly owned and of itself operating utilities and the other two purely regulatory of both privately and publicly owned systems, all agree that all rural electrical systems should be separate units insofar as possible, each financially independent of any other system.

The Human Side of Our Business

By BRITTON I. BUDD

THERE is a trite saying that "There is no Sentiment in Business." Equally shopworn is the phrase that corporations are "soulless." The fact that so many representatives of large corporations and of big business enterprises are here today to discuss methods of conserving human life and limb, is as complete a refutation as could be found, of the challenge that corporations are soulless and that there is no sentiment in business.

I have been asked to present something to you on "The Human Side of Our Business," and in doing so, I shall approach the subject from a different angle than that usually taken at safety gatherings of this kind. By that I mean that I shall not dwell on the human misery caused by accidents, of the homes broken up, the widowed mothers and the helpless orphans, which modern industry creates, the number of whom, happily, is being gradually and surely reduced year by year by the excellent educational work carried on by the National Safety Council. That particular phase of the "Human Side of our Business" is well understood and fully appreciated by all who are engaged in this great work of accident prevention. It makes an appeal which no one can resist.

But there is another angle to the human side of our business which is closely related to accident prevention, and which, I think, sometimes is not as much emphasized as it ought to be.

Decent treatment by men in a supervisory capacity of those working under them is, in my judgment, as much of a factor in accident prevention as the safety devices which we place on dangerous machines, and on which we lay so much stress. I will go farther and say it is a more important factor, because if workmen are not treated as thinking human beings by those having authority over

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them, they are constantly in such a frame of mind that they will cause accidents in spite of all the safety devices and precautionary methods that can be adopted.

It is a common saying that the best safety device is a careful man. I fully agree with that saying, but would add that to make a man careful you must treat him in a way that makes him contented in his work, in a way that will make him glad to meet his foreman or superintendent rather than afraid to meet them. That is the human side of our business which I wish to emphasize.

Fear is one of the causes of accidents. Frequently we call it "carelessness," but if we look more carefully into the subject, we may discover that the seeming carelessness was due to a nervous condition.

Those who have made close study of accidents in a shop or factory have found that a frequent cause of accident is some trouble over which the workman was brooding at the time the accident occurred. The cause of the brooding may have been some family trouble, or some difficulty with a foreman or a superintendent, but it was sufficient to bring on a nervous strain that took the workman's mind off his work.

How many times have you observed a workman under the critical eye of a foreman become so nervous and excitable that he scarcely was conscious of what he was doing? Some workmen are of an excitable temperament, and it requires only some tactless act on the part of a foreman to put them in a frame of mind in which they are largely irresponsible.

Men in positions of authority have a great deal of responsibility in the matter of safeguarding the lives and limbs of workmen under them. In some respects they bear the same relation to the men under them that the father does to his child. A wise father does not exact obedience from his child through fear of punishment, but through respect. He must set a good example and win the child's confidence by kindliness. A child in constant dread of his father may, for a time, have respect for authority, but soon he will have little respect for the father.

It is the same with the foreman or superintendent who seeks to enforce discipline by harsh treatment of the workmen under him. He loses their confidence, with the result that the character of the work itself is inferior and the danger of accidents is greatly increased. What is needed is a little more human understanding, or, in other words, a closer study of the human side of our business. Everyone who has had experience in dealing with men knows the effect of an accident on the morale of the working force. For a time after the accident takes place, the shop or railroad is demoralized. Fear has crept in and weakened the morale.

So it is if the men are in constant fear of their foreman or superintendent. The morale of the force is weakened, and to that extent the danger of accidents increased.

I do not wish to convey the impression that I think men always should be patted on the back, or that strict discipline should not be maintained. Although I believe there is, and should

be, some sentiment in business, I do not believe in sentimentality. My contention simply is that the cheerful manner, the sympathetic word, the kindly act will bring much better results than the gruff and domineering manner or harsh treatment.

In the electric railway industry, with which I am connected, the human side is of the greatest importance. Success in our industry is dependent on the good will of the public, and the public forms its opinion of a company largely by the conduct of the employees with whom it comes in direct contact.

It is of the greatest importance, therefore, that the employees of a company engaged in the service of the public, be cheerful and contented in their employment, that they be courteous and polite to the customers of the company, that they, in fact, consider themselves a part of the company.

To produce such a spirit among employees, it is essential that they be treated as human beings. If those in authority do not treat the men under them with proper respect, how can they expect the men to treat the public courteously and respectfully? How can a foreman or a superintendent who does not exercise self-control when dealing with his men expect to have those men exercise self-restraint when dealing with a troublesome, maybe an abusive passenger? He may daily preach to his men on the necessity of exercising self-control, but if he does not set them an example himself, his daily preachments will have little effect. Contentment comes as a result of humane treatment. It radiates from the employees to the traveling public.

It is essential that employees serving the public be in a happy and contented frame of mind. When they are, their good humor extends to their passengers. On the other hand, if the employees are grouchy and irritable, their manner irritates their passengers. Keep employees in a contented and happy frame of mind and many of our troubles will disappear.

Human nature is much the same the world over. Seldom do we find a man so callous that he will not respond to a touch of real human sympathy. Seldom do we find a man who will not inwardly, if not outwardly, resent unjust or harsh treatment.

The brief message which I wish to bring to you men, most of you occupying positions of authority, is that the human side of our business is more important even than the financial side, because it is necessary to the financial success of our business that we establish and maintain good human relations. The more attention we pay to the human side of our business, the more successful will we be on the financial side. The better our human relations are with the men who work for us, the safer will our operations be, whether on the railroad or in the shop or factory.

Accident Prevention by Higher Executives

Accidents constitute a great source of waste and often receive less attention than economy of material or labor. The latter registers directly on the expense account and frequently compels greater initial consideration than loss of life or limb, which can only be surmised, and which requires special study and experience in order to be understood.

J. H. Eustace, chief operating engineer of the Peoples Gas Light and Coke company, of Chicago, in his address before the National Safety Council, points out that this condition is not generally appreciated. Accidents in Ohio cost eighty million dollars from 1912 to 1920, and resulted in additional loss due to greater labor turnover and its effect on production. Statistics indicate that seventy-five per cent. of the accidental deaths in this country are preventable, and indicate an almost criminal unconcern of the value of human life.

Educational and safety propaganda are necessary and useful, but will not always accomplish results alone. The man in charge of the job is often the real though unrecognized cause of accidents.

An experienced man undertook to clean foreign material from a sixty-thousand-volt disconnecting switch with the power on, which was against strict regulations. His life was lost, and in fairness it cannot be said that any great amount of blame could be attached to those in charge. A prime mover in an inclosed space ran away and exploded. Men working near it were killed by steam while trying to escape. The hand throttle valve was not accessible, as otherwise, the steam could have been shut off in time; the designing engineer did not figure on an accident. Men have been sent to turn steam into headers on many occasions where water was encountered and an explosion produced. The chief engineer did not take the proper precautions in supervising the work. It would not have occurred if he had taken the chance himself, with proper precaution in the beginning.

How many times in the drafting room is the price of a valve, pipe connection or disconnecting switch saved at the cost or risk of an accident? Ignorance of the danger involved or unwillingness to incur expense is often commented on by the practical men who operate such devices. An instance could be mentioned in which the dangerous condition of a badly aligned machine was pointed out; but the judgment of the operator was discounted. An explosion occurred as predicted, though fortunately without injury to human beings.

Safety precautions often involve an engineering knowledge and practical skill that cannot be learned from books or statistics. It is not the desire to avoid expense so much as the lack of true appreciation of the risks involved that frequently leads to disastrous mistakes.

Mr. Eustace suggests "the man on the job is, after all, in the best position to judge unsafe conditions and practices, and if he is taught to think safe-

ty , and encouraged to make suggestions for accident prevention, he not only becomes a booster for safety, but feels that he is something more than a cog in the machinery, and becomes a more efficient workman."

"Such training, however, cannot be imparted without being supported, not only in theory, but in fact, by the executives of the company; with the personal interest of such supervisors and the chief engineers and the knowledge throughout the organization, that this support and interest is really accorded. To satisfy the men that the company is in earnest, all suggestions as to safety received from an employee, whether good or bad, should be acknowledged, so that the man may feel that his efforts toward safety are appreciated."

—*Power,* September 19, 1922.

Ranney's Falls Development

THE Commission's new generating station at Ranney's Falls, on the Trent River, near Campbellford, is now completed and in operation. This station is the seventh of a chain of generating stations supplying power to the Central Ontario System from the Trent River. The combined generator rating of these plants is approximately 36,000 horsepower. The new station is nominally rated at 10,000 horsepower, and will operate under a normal head of 48 feet.

In the construction of the Trent Canal, below Dam No. 10, the Dominion Government installed intake sluices in the canal wall immediately above locks 11 and 12. It is through these sluices that the water is obtained

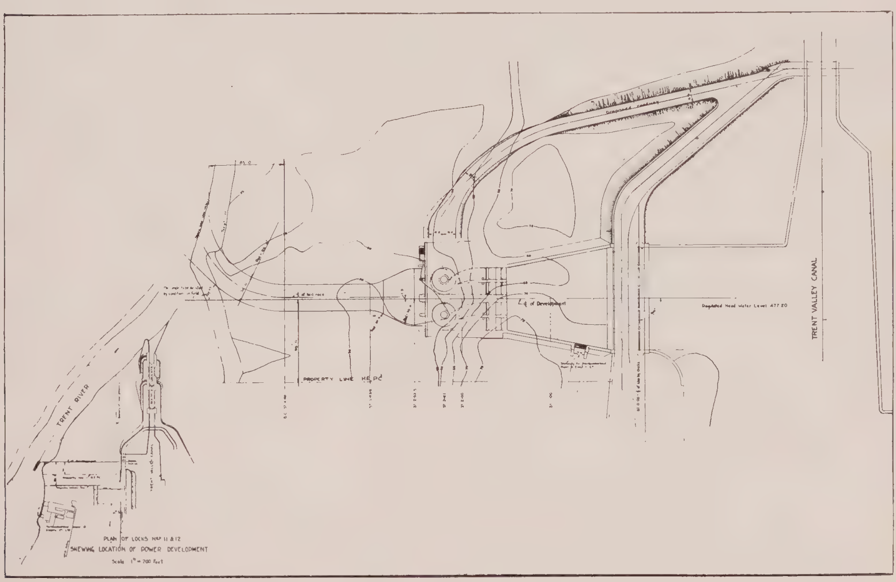

Figure 1. General Plan of Development.

for operating the Ranney's Falls plant.

Figure 1, shows the general plan of the development—the insert shows the relative position of the plant and locks 11 and 12. Figure 2, shows a section through one unit.

An open forebay, 124 ft. in length, connects the sluices to the power house. The regulated canal level at this point is 477.0 (sea level datum). From the power house the tailrace, 30 ft. in width, extends 275 ft. to the Trent River, the level of which at the junction with the tailrace, is 429.0. The forebay is 116 ft. wide by 12 ft. deep, at the intake. The side walls converge, and the forebay increases in depth, until at the gatehouse the dimensions are 71 ft. wide by 24 ft. deep. This design is conducive to low velocity at the racks.

The gate house substructure is a block of reinforced concrete, 84 ft. by 30 ft., in plan. There are four entry chambers, two for each unit, 14 ft. in width. The racks are at the head of these, and built of structural steel in two sections. In the centre pier of the gate house a 5 x 4 ft. chute is provided to carry off any ice or other floating material from the forebay.

The double supply pipes connecting the gate house to the turbine cases are each provided with a gate of the "Stoney" type. One gate for each unit being of the sliding type, and the other of the rolling type. The supply pipes are of reinforced concrete.

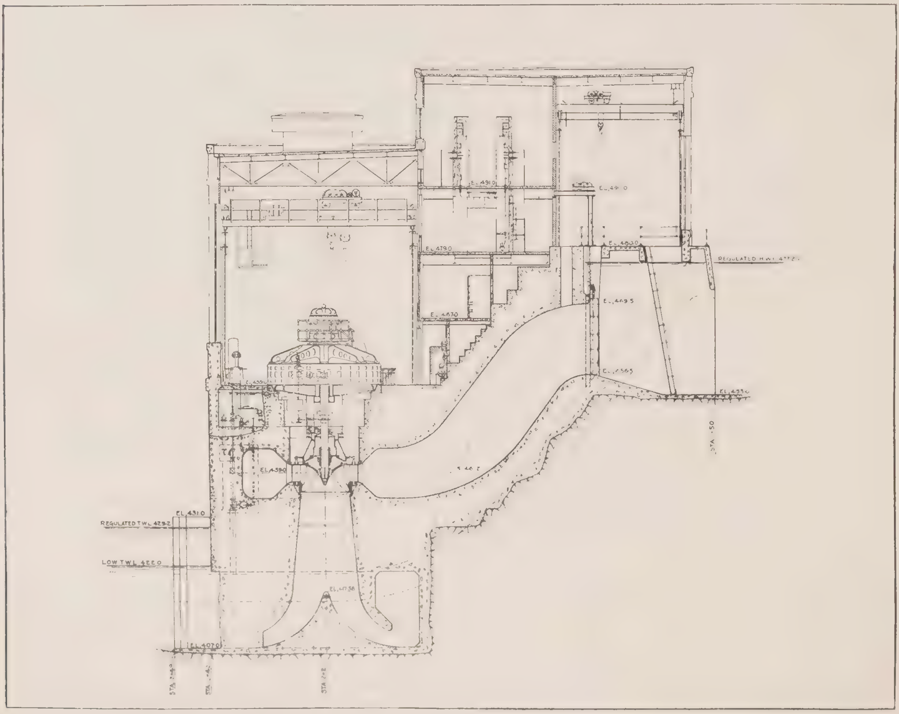

Figure 2. Section Through Unit.

Figure 3. Downstream Elevation showing Draft Tubes.

The double supply pipes converge at the bottom, leading the water to the turbine scroll cases in the proper direction, with minimum eddy loss.

The two turbines are of the vertical single runner type, each direct connected to a 4,500 kv-a. generator. The turbines were supplied by the Boving Hydraulic & Engineering Co. They each have a rating of 5,000 h.p. at 120 r.p.m., when operating under 47 ft. head. No. 1 turbine is equipped with a Moody spreading draft tube, (shown on the right, in Figure 3). No. 2 turbine is equipped with a tube built in accordance with the design of the turbine manufacturers (shown on the left in Figure 3). The turbines are controlled by Woodward Oil Pressure Governors. The governor oil pressure is supplied by two motor driven pumps. The piping is arranged so that either pump may operate both governors, if necessary.

For test purposes a sharp crested weir has been built in the tailrace, about 130 ft. from the power house. Piezometer openings have also been left in the scroll cases for carrying out tests by the Gibson method.

The structure and walls up to the sills of the large arched windows are re-inforced concrete. Above this point the walls are built or squared stone masonry. The interior finish is plaster over hollow-tile, except in the gate house, where the plaster is applied to the stone work. Most of the

stone in the walls was obtained from the tailrace excavation.

Figure 4, shows plan and elevation of the station, above the generator floor. Figure 5, is a single line diagram of the electrical layout.

The two generators were supplied and erected by the Canadian General Electric Co. These machines are normally rated at 4,500 kv-a., 3 phase, 60 cycle, 6,600 volts, 120 r.p.m., at 80 per cent. power factor; but are capable of carrying 5,300 kv-a. at 80 per cent. power factor, with cooling air, at an ambient temperature of 15 degrees centigrade. The rotor is designed so that no fan blades are required to force cooling air through the windings. The cooling air after passing through the generator will be re-circulated and used in winter time for heating the station.

The thrust bearing on each generator is a standard General Electric spring type. It is designed to carry a load of 190,000 lbs., and to adjust itself automatically while in operation, to loss of alignment. Both circulating oil and water, for cooling are installed on this bearing. Sight flow indicators are used on both oil and water supply.

A water connection controlled from the switchboard is installed on each generator for fire fighting.

Each unit is equipped with air brakes controlled either from the governors on the main floor or from the switchboard-room.

Twelve thermo couples are distributed throughout the stator windings for taking internal temperatures.

Shop tests were made on each machine, including overspeed tests at 185 per cent. normal speed. The over-all

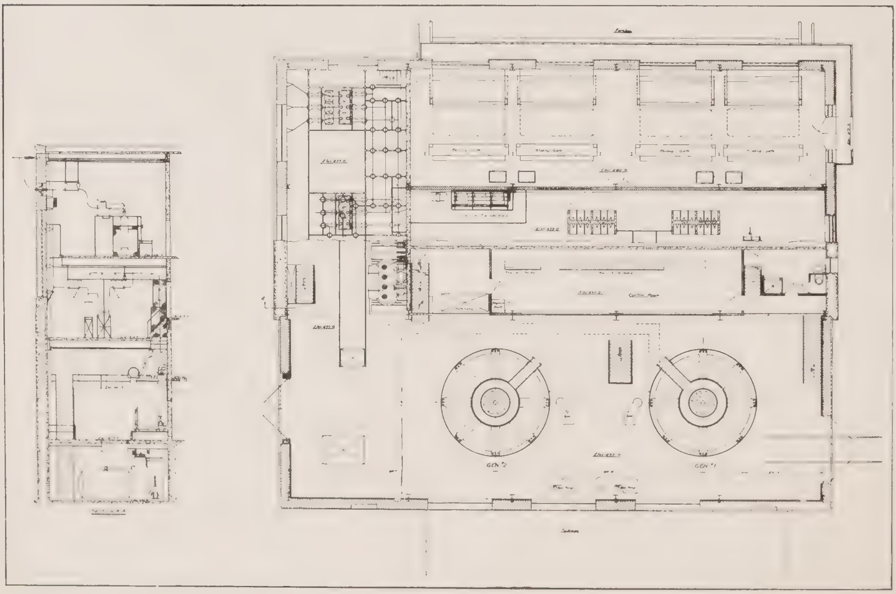

Figure 4. Plan and Elevation of Generator Room.

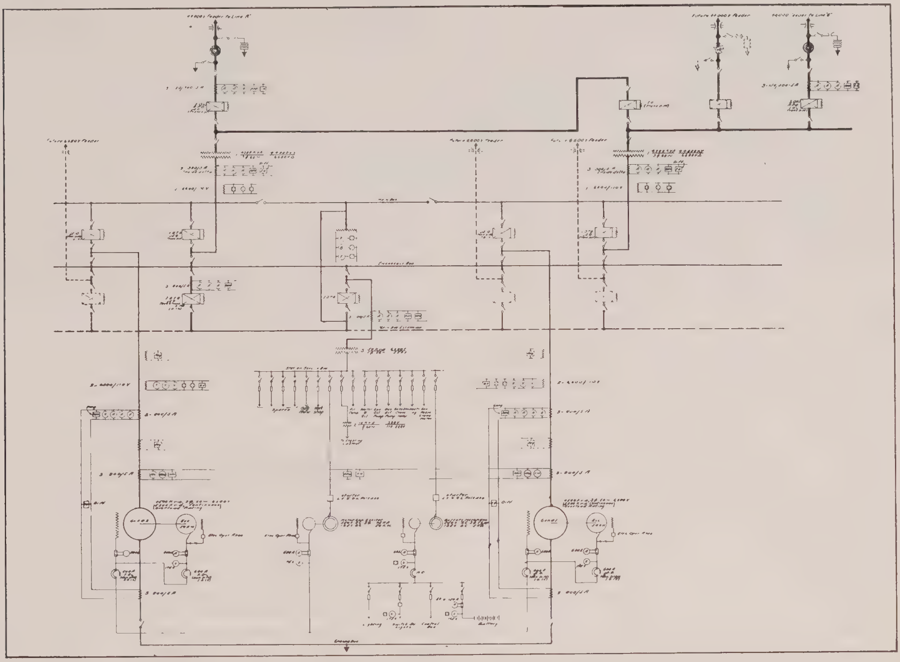

Figure 5. Wiring Diagram.

efficiency of the generators, including the direct connected exciters, is 94.6 per cent. at full load, 80 per cent. power factor.

Each generator is equipped with a 50 k.w., 125 volt, shunt wound exciter mounted on an extension of the generator shaft. A spare 50 k.w. motor driven exciter set is provided.

The leads from the generators to the station bus are 310,000 cir.mils. varnished cambric double braided insulation and carried in fibre conduit from the generators to the bus.

Differential protection is provided, consisting of 3 single pole relays which will, in case of trouble, open the generator main breaker or the emergency bus feeder switch (if it is being used as a generator switch) and both field switches, one from the direct connected exciter and the other from the motor driven exciter.

An overload relay will operate a gong in case of overload on the machine.

An ammeter is connected in the neutral of the current transformers and will indicate when the generator is grounded and the extent of the ground.

The main step-up transformers consist of two 6,600/44,000 volt, 3 phase, 4,500 kv-a. 60 cycle core type water cooled units equipped for outdoor service. They are connected delta on the low tension side and star on the high tension side. These units have a 125 per cent. continuous overload capacity at a 55 degrees centigrade rise. They have a full load efficiency of 98.6 per cent. at 80 per cent. power factor.

The transformers are located on the generator floor. A transfer truck has been provided so that these units can be readily placed under the generator room crane.

A wall 18 inches high has been built around each unit with a 6-inch drain direct to the tailrace to carry off the oil in the event of a tank bursting. An oil tank with slightly over the oil capacity of one transformer has been installed in the basement with a pipe connection to the transformers.

The high tension side of each transformer connects direct to the bus through disconnecting switches.

A single pole relay, operated from current transformers inside the delta provides differential protection. A push button is provided in the tripping circuit through this relay so that when exciting the transformers the breakers can be made non-automatic.

When the relay operates, the low tension circuit breaker, the high tension bus tie, and high tension line circuit breaker from that section of the high tension bus, all open automatically. Overload protection consisting of 3 single pole relays is also provided.

Each unit is equipped with an electric alarm thermometer, sight flow water indicator, oil gauge glass on both main and expansion tank and an oil sampling valve.

Owing to the limited space available for the switchboard, all the

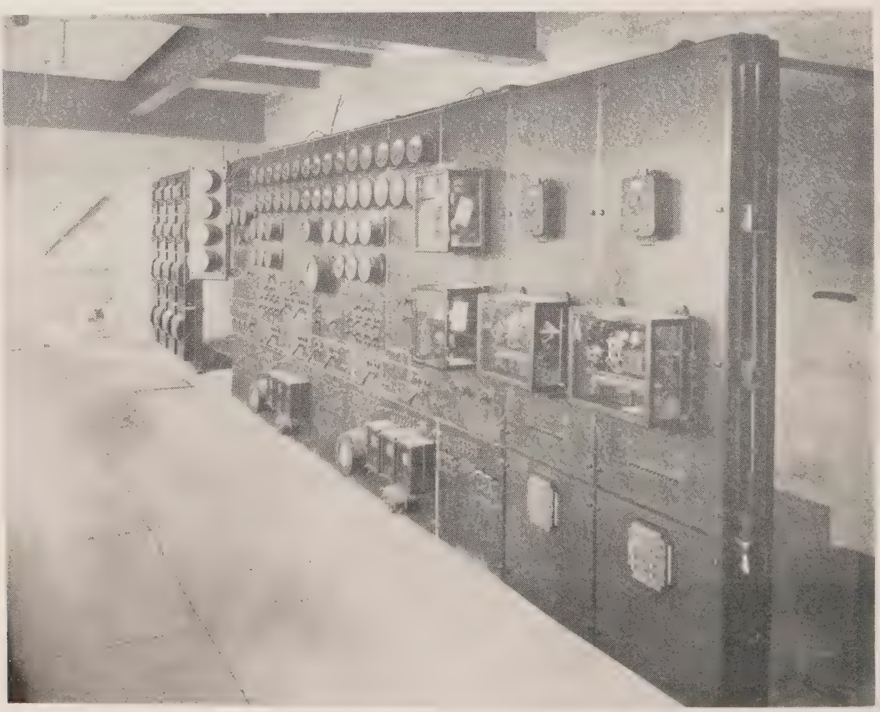

Figure 6. Main Switchboard.

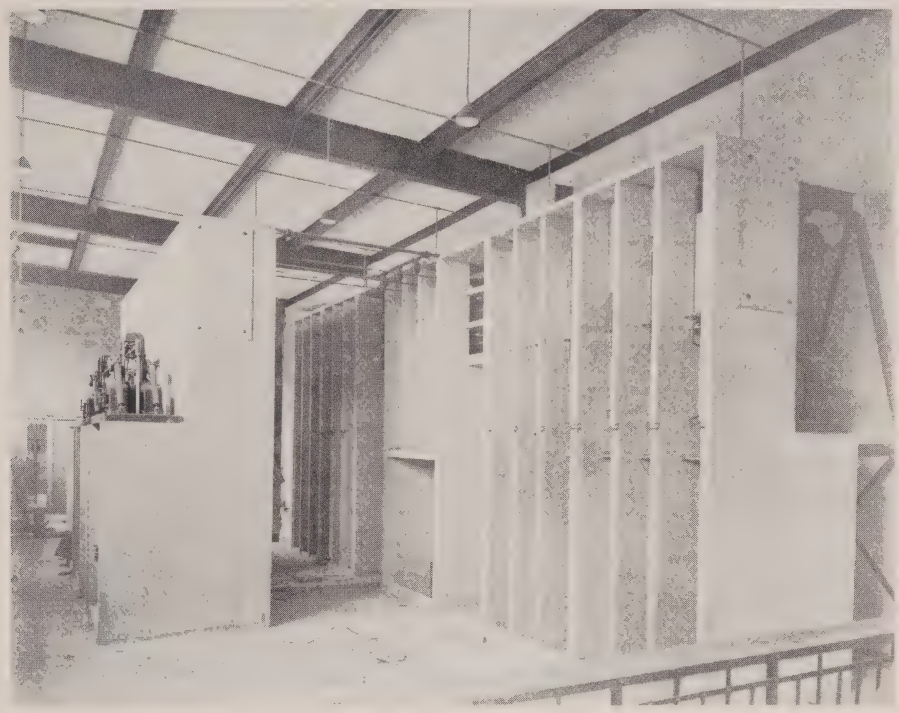

Figure 7. 6600 volt Switch Structures.

equipment was placed on vertical panels.

Figure 6 shows the front of the main switchboard.

All vertical wires are run within the upright supports of the board. These supports consist of two 2 x $1\frac{1}{2}$-inch angles in the form of a channel, and removable covers have been provided.

The control, synchronizing and potential buses are located at the top of the framework, leaving all the rear of the switchboard clear for equipment.

Two synchroscopes are provided on the swinging panel, one to check the other. A set of synchronizing lamps is also provided.

A dummy bus using various colors for the high tension, low tension and emergency bus, has been installed on the switchboard. The signal lamps are supplied with power from a separate bus, the voltage of which is controlled by a rheostat.

The 6,600-volt oil switch structure (Figure 7) is built of concrete, the main walls and barriers being poured. Doors of wood and glass are used over disconnecting switches, wood and asbestos being used over other equipment.

The potential transformers are located in separate pockets and protected by fuses in separate pockets as well as by resistances in series. These

resistances are in the form of disconnecting switches.

The high tension switches are all mounted in a row as shown in Figure 8. These switches have condenser bushings for use indoors and are capable of rupturing 225,000 kv-a.

The bus tie is non-automatic and at the present time forms a tie between lines "G" and "R" of the transmission system.

The high tension bus and connections are all No. 0000 bare copper supported on 44,000 volt line insulators with a cemented cast iron cap.

Provision has been made for grounding all high tension lines by closing disconnecting switches.

The station service bank of transformers, 3-50 kv-a., single phase, is fed from the main 6,600 volt bus. Three phase 550 volts is delivered from this bank via the service switchboard to the cranes, oil and water pumps, air compressor, heating in switchboard room, and gate house motors.

The generator room is served by a 35 ton motor driven travelling crane with an auxiliary 10 ton hook.

The gate house has a 7 ton overhead crane with a motor driven hoist with hand power bridge and trolley.

The lubricating oil for the generator bearings is supplied through a continuous filtering system. The oil after coming from the bearings passes through canton flannel bags.

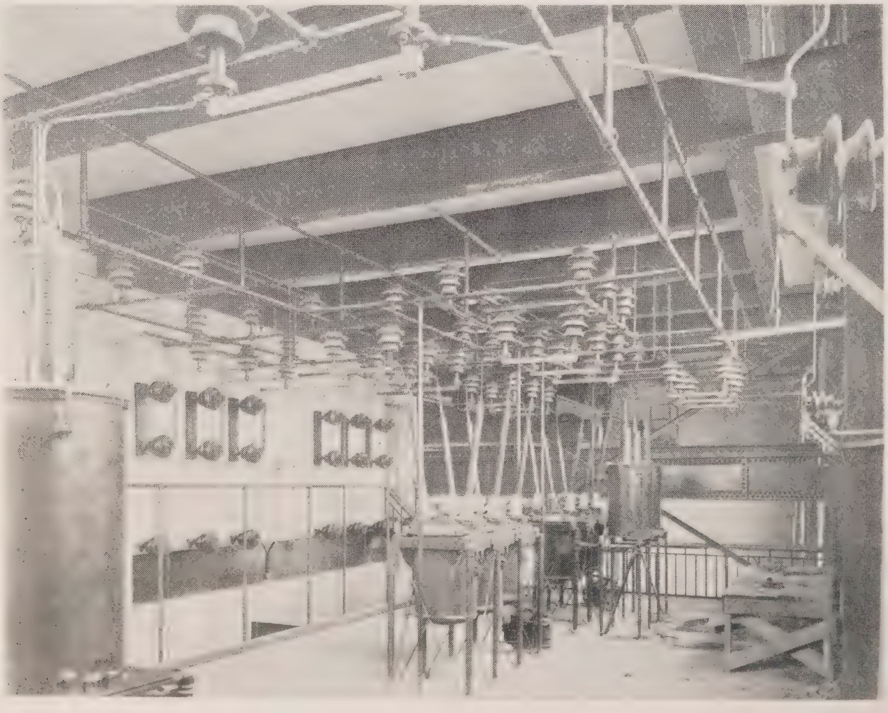

Figure 8. High Tension Switch Room

The good oil chamber provides space to contain all the oil in the system in case of a shut-down.

An overflow tank containing enough oil to supply the generators for about an hour is mounted on the roof trusses, and would continue to supply oil by gravity to the generator bearing in case the pumps fail to operate.

An air receiver is kept charged to accommodate the air brakes, by means of a small compressor with a capacity of 17 cubic feet per minute, installed in the basement of the station. Air for cleaning equipment and for small pneumatic tools may be obtained from this source.

Cooling water for the generator thrust bearings and for the transformers is supplied by duplicate pumps in the basement, water being taken from the turbine scroll case. The supply for the protection of the generators in case of fire, is taken from this system.

The lighting for the building is supplied from two 10 kv-a. transformers. The lights for all parts of the station are controlled from one central cabinet on the switchboard floor. Some of the lights in the different rooms can be connected to the battery in case of emergency, by means of a switch located near the operator's desk. Receptacles have been provided throughout the building for portable lights and small electrically operated tools.

Electric heating at 550 volts is installed in the switchboard room. It is the intention, in cold weather, to draw all the cooling air for the generators from the main generating room, closing off the supply direct from outside. Registers are provided in the ventilating duct so that warm air may be supplied to the basement and pit between the generators.

Forced ventilation by means of a small electric fan has been provided for the switchboard room and the lavatory; air can be drawn from the generator room or from outside.

The lavatory is equipped with a shower bath. Locker space is provided on the first gallery.

A circulating electric water heater has been installed for hot water in the lavatory.

* * *

Some Comment on Distribution of Power for Appliance Loads

By J. H. CASTER,
Assistant Engineer, H. E. P. C. of Ontario

CONSIDERABLE difference of opinion has been expressed by the various Superintendents regarding the number of ranges that can be handled by one transformer. Experience has shown that there is considerable diversity between ranges in different houses and also on the individual range. Also that the secondary circuits are not of ample size to carry the current without excessive drop. Table No. 1 can be used as a guide in loading transformers and also for the size of copper required for a 110/220 volt line. It is assumed that there will be the ordinary amount of appliance and lighting load connected in addition to the ranges.

In the above table drop only has been considered, but it is obvious that where the cost of power is high, large copper is more essential. In all cases we must supply the customer with proper voltage in order that the appliance will operate satisfactorily. As the standard voltage for which appliances are built is 110, it is necessary that we have 110 volts at the appliance and it is not good enough to have 2,200 volts at the station and give no care to our lines. The conditions shown in Table No. 2 are typical of the drop from the appliance to the station.

TABLE SHOWING THE NUMBER OF RANGES WHICH MAY BE SERVED BY ONE TRANSFORMER

5 Kv-a	3	5 amp.	2 No. 4—1 No. 6
7½ Kv-a	5	7 amp.	2 No. 2—1 No. 4
10 Kv-a	8	10 amp.	2 No. 0—1 No. 4
15 Kv-a	10	12 amp.	2 No. 0—1 No. 2
20 Kv-a	15	15 amp.	2 No. 00—1 No. 2
25 Kv-a	20	18 amp.	2 No. 00—1 No. 0

Table No. 1.

Section	*Voltage drop.*	*Average drop, volts.*
Service Wire, standpipe and interior wiring	1- 6	3
Secondary wire on street from service to transformer	2-10	5
Transformer (Regulation)	2.5- 5	3
Primary line, Transformer to station	0.5- 5	2

Table No. 2.

From the foregoing it is seen that to give 110 volts at appliance, we need 113 volts at service, 118 volts at the secondary of transformers and 121 x 20 or 2,420 volts on the primary of the transformers. This can be reduced only by increasing the size of conductor (1) on the customer's property, (2) on our secondary lines, and it is good practice to keep within the limits set out above. It is also of the greatest importance to purchase transformers designed for the voltage at which they will be used, viz., 2,400/120-240, otherwise the exciting current will be excessive and result in a heavy power factor penalty and poor regulation.

Under ordinary conditions, a transformer having an exciting current not exceeding 3% at 2,400 volts is quite satisfactory. A transformer having 10% exciting current is only worth approximately 50% as much as one with 3% with power costing $30.00 per h.p. per year, other conditions being equal.

Too much attention cannot be given to the transformers and secondary circuits if proper service at an economical price is to be maintained.

Hydro News Items

Central Ontario System

The Corporation of Oshawa has annexed a suburban district known as Cedardale, lying south of the Grand Trunk Railway. The additional population in this area will likely result in Oshawa becoming a city.

* * *

The Corporation of Oshawa has ordered 130 additional street lights for installation in the outlying sections of the town. Pole type regulators are proposed to operate the new series circuits required.

* * *

The Police Village of Warkworth submitted enabling and debenture by-laws in connection with a supply of Electric Service on December 8th. Both by-laws were carried.

* * *

Niagara System

Rural extensions in the Woodstock, Delaware and Exeter Rural Power Districts have been completed and put into operation. In these districts there are 87 miles of 4,000 volt line and 430 consumers are receiving service.

* * *

The construction in the Markham Rural Power District to Unionville has been completed and service is being given. The line is 9 miles in length and serves 100 consumers.

* * *

The rural line from St. Jacobs to Conestogo has been completed and was put into operation on November 30th. Service is given to 50 consumers over 4 miles of line.

* * *

Toronto Township which was the first to give rural service on its own account, works under the same plan as the urban municipalities, limiting the area to that served. A by-law is being submitted at the January elections to increase the area in the Township in which electrical service may be given.

* * *

The Police Village of Agincourt had been receiving electrical service as a part of the Scarboro Township system. This arrangement has been changed and the Village is now operating as a separate municipality.

* * *

Rideau System

The Grenville Crushed Rock Co. has ceased operation for the season, but will resume taking power again next March.

* * *

Smith Falls has taken advantage of a recent by-election to hold its annual municipal elections. Dr. Anderson will be the new mayor and ex-officio member of the local commission.

* * *

Severn System

Arrangements are nearing completion for the extension of a single phase 4,000 volt line from the Stayner Substation to Wasaga Beach. A tender covering the furnishing and erection of all poles for this line has been presented and accepted by the Commission and work will be undertaken as soon as possible in the Spring. Approximately 110 contracts have been signed for service at the Beach, including a number of large boarding houses and hotels. It is anticipated that as soon as the service is available that approximately 90 additional contracts will be obtained.

* * *

St. Lawrence System

Information has been submitted to the Village of Cardinal on the valuation of the existing distribution system in this Village. The Council has deferred until next Spring further action towards obtaining a supply of electric energy from this Commission.

* * *

Wasdell System

A contract has been executed between the Township Council and the Commission covering general rural service throughout the Township, and arrangements are being perfected whereby construction work will be undertaken early in the Spring. The initial system will consist of approximately 15¼ miles of 4,000 volt line, constituting the rural system which will be fed from a substation approximately two miles off the main 22,000 volt line between Cannington and Greenbank, which will require an extension of about two miles of 22,000 volt line. A total of 96 contracts have been obtained. The Police Villages of Little Britain and Oakwood will be included in this rural system.

Association of Municipal Electrical Utilities

Election of Officers for 1923

Ballot papers for the election of officers for the year 1923, will be distributed to the delegates at the time of registration at the Convenion on January 25th and 26th, 1923. These ballots are to be marked and returned at the beginning of the opening session of the Convention on the afternoon of the 25th. The scrutineers will then proceed to count the ballots and will make their report before the close of that session.

The ballots will contain the following names:—

President—

A. T. Hicks
(Acclamation)

Vice-President—

J. E. B. Phelps
R. H. Staford

Secretary—

S. R. A. Clement
(Acclamation)

TREASURER—

D. J. McAuley
Geo. J. Mickler

DIRECTORS AT LARGE —
(3 to be elected)

E. V. Buchanan
E. H. Caughell
M. J. McHenry
V. S. McIntyre
H. F. Shearer
E. I. Sifton
R. H. Starr
P. B. Yates

DISTRICT DIRECTORS—

Niagara District

W. R. Catton
J. J. Heeg
A. B. Scott

Georgian Bay District

J. A. Foerster
W. H. Gurney
A. Martyn
J. R. McLinden
E. J. Stapleton

Central District

G. E. Chase
W. E. Reesor
C. A. Walters

Eastern District

To be named by Convention.

Northern District

S. A. Saylor
(Acclamation)

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THE

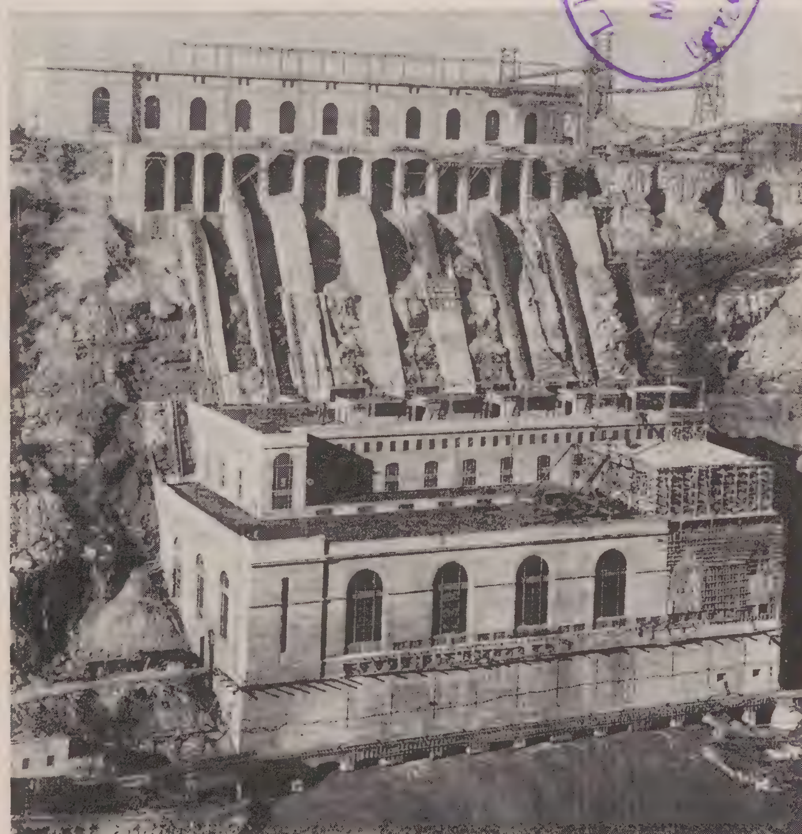
BULLETIN

Vol. X. No. 1

Hydro-Electric Power Commission of Ontario

January

1923



Generating Station, Chippawa-Queenston Development.

HYDRO MUNICIPALITIES

CENTRAL ONTARIO SYSTEM

	Pop.
Belleville	12,243
Bloomfield	550
Bowmanville	3,250
Brighton	1,375
Camden East Twp.	2,982
Cobourg	5,108
Colborne	829
Darlington Twp.	3,407
Deloro	298
Deseronto	1,928
Havelock	1,266
Kingston	22,368
Lakefield	1,146
Lindsay	7,840
Madoc	1,078
Marmora	855
Millbrook	733
Napanee	2,847
Newcastle	619
Newburgh	434
Norwood	711
Omemee	557
Orono	700
Oshawa	12,246
Peterboro	21,790
Pickering Twp.	4,382
Picton	3,189
Port Hope	4,567
Richmond Twp.	1,944
Seymour Twp.	2,506
Stirling	778
Trenton	5,576
Tweed	1,268
Wellington	850
Whitby	3,975
Whitby Twp.	1,785
Whitby E. Twp	3,747
Total	141,725

ESSEX COUNTY SYSTEM

Amherstburg	2,500
Canard River	50
Cottam	333
Essex	1,753
Harrow	619
Kingsville	1,827
Leamington	3,668
Total	10,750

EUGENIA SYSTEM

Alton	450
Artemesia Twp.	2,316
Arthur	1,218
Chatsworth	326
Chesley	1,721
Derby Twp.	1,507
Dundalk	690
Durham	1,400
Elmwood	350
Flesherton	417
Grand Valley	595
Hanover	2,842
Holstein	285
Horning's Mills	350
Kilsyth	
Kincardine	2,036
Lucknow	918
Markdale	927
Mount Forest	1,825
Neustadt	444
Orangeville	2,427
Owen Sound	12,013
Priceville	
Ripley	670
Shelburne	1,075
Tara	597

	Pop.
Teeswater	807
Wingham	2,337
Total	40,543

MUSKOKA SYSTEM

Gravenhurst	1,432
Huntsville	2,176
Total	3,608

NIAGARA SYSTEM

Acton	1,594
Ailsa Craig	535
Ancaster	400
Ancaster Twp.	4,124
Aylmer	2,241
Ayr	796
Baden	710
Barton Twp.	6,742
Beachville	503
Biddulph Twp.	1,640
Blenheim	1,528
Bolton	656
Bothwell	630
Brampton	4,406
Brantford	32,786
Brantford Twp.	7,168
Breslau	500
Brigden	400
Burford	700
Burford Twp.	3,886
Burgessville	300
Caledonia	1,308
Chatham	15,525
Chippawa	1,099
Clinton	1,838
Comber	800
Copetown	230
Dashwood	350
Delaware	350
Dereham Twp.	3,200
Dorchester	400
Dorchester S. Twp.	1,436
Drayton	602
Dresden	1,393
Drumbo	375
Dublin	218
Dundas	5,054
Dunnville	3,569
Dutton	870
Elmira	2,400
Elora	1,199
Embro	463
Etobicoke Twp.	10,463
Exter	1,458
Fergus	1,815
Flamboro E. Twp.	2,624
Forest	1,386
Georgetown	2,554
Glencoe	779
Goderich	4,287
Grantham Twp.	3,456
Granton	300
Guelph	17,922
Galt	13,092
Hagersville	1,139
Hamilton	120,235
Harriston	1,326
Hensall	687
Hespeler	3,059
Highgate	403
Ingersoll	5,422
Kitchener	23,027
Lambeth	350
Listowel	2,571
London	61,639
London Twp.	6,073
Louth Twp.	2,312
Lucan	614

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CONTENTS

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JANUARY, 1923

Municipal Co-operation

Co-operation is a word in very common use, and the principle has been advocated and applied in a great many ways. It is the basis on which the whole structure of the Hydro-Electric Power Commission is built. Without the co-operation among the municipalities they could have done nothing.

We give herein a brief outline of the structure of the Ontario municipal co-operative method of obtaining and distributing electrical energy through the Commission. The principle has been worked out to such detail that it is made to apply not only to the municipalities, but also to all of their consumers, regardless of the amount of electricity used.

* * *

Household Electric Refrigeration

The results arrived at by Mr. T. I. Jones in his investigation of household electric refrigeration are of especial interest, but in applying them to Ontario conditions his costs must be amended to conform with the lower domestic rates. Mr. Jones has used a rate of 5 cents per kilowatt-hour as applied to refrigerators, and 8 cents per kilowatt-hour for other uses.

In the Hydro Municipalities the second domestic rate, under which this class of service will come varies between one and two cents per kilowatt hour with a 10 per cent. discount. The operating expense of $30.00 for the smaller machines shown in Tabulation 1 will therefore vary between $5.40 and $10.80, depending upon the rate in use, giving a reducion in the total annual cost of electric refrigeration, as shown of from $24.60 to $19.20. Where a one cent rate is in use Machine No. 1 would show a total

annual cost of $57.40, which is less than the cost of ice refrigeration in the same class.

Similarly with the larger machines. The operating expenses for these will vary between $6.30 and 12.60, depending upon the rates. The item of $35.00 will be reduced between $28.70 and $22.40, making Machine No. 1 less than the cost of ice refrigeration with the highest rate in use, while Machine No. 2 Type A will cost but $77.50 per year at the one cent rate, which is also lower than the result shown for ice.

* * *

The Convention

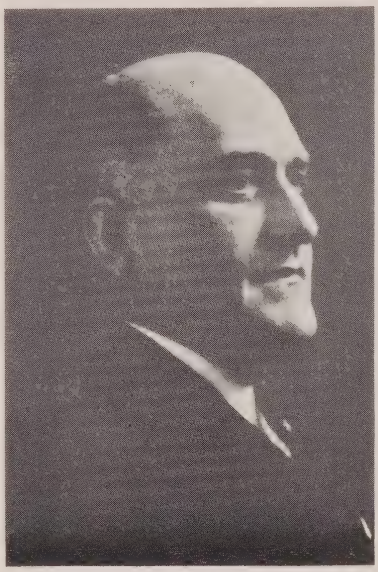
The February issue of The Bulletin will be devoted exclusively to reporting the proceedings of the Convention of the Association of Municipal Electrical Utilities, which was held at the Prince George Hotel, on the 25th and 26th of this month.

The convention was the most successful winter convention ever held by the Association both as to attendance and to the papers, addresses and discussions. The proceedings of the various sessions of the convention will be given in the next number and will contain many things of value to the Utilities. The Association is to be congratulated on having obtained these contributions, while the contributors deserve the highest praise.

The convention dinner was an event of especial note when Sir Adam Back as guest of the Association addressed the delegates. His reception showed that unity of spirit that exists among the utilities, in acclaiming him as their mainstay and inspiring leader. His address contained one great note of warning. The industry was going ahead in great strides. In some districts the demand was getting very close to the visible supply and something must be done to provide for the future at once or the year 1926 would see the Province of Ontario faced with a great power shortage. The solution offered by him was the immediate co-operation of the various bodies for the development of the water powers now going to waste on the St. Lawrence River, and establishing there power plants for the generation of electricity and of transmitting it at a high voltage to the various parts of the province where the power shortages are becoming acute. It is urgent that immediate action be taken.

Our New Commissioner

J. G. RAMSDEN, the subject of this sketch, is just two days younger than the Dominion of Canada, having been born at Pomona Mills, Thornhill, Ont., July 3rd, 1867. His father, John Ramsden, was a native of Huddersfield, Yorksire, England, coming to this country and settling in Markham Township, York County, in 1838, his mother, Jane Bowman, daughter of James Bowman, native of the north of Ireland, arriving some years before and settling in the same township. He married Barbara Spring, whose ancestors settled in Markham about 1792, so Mr. Ramsden not only on date of birth but also from ancestry, claims to be a full blooded Canadian. Mr. Ramsden married Effie Carman, also a descendant of one of the old Markham families, and is the father of six children, one of whom is Jack Ramsden, M.C., M.P.P., South West Toronto. In religion he is a Methodist.



Commissioner, J. G. Ramsden

He received his early education in East Gwillimbury Township, Thornhill Public School and Richmond Hill High School, afterwards taking a course in the British American Business College. He then entered the office of Christie, Brown & Co., and was afterwards in the baking business as head of the firm of Ramsden & Lloyd, who had a number of establishments in Toronto.

He was for some years Chief Inspector and Commissioner of Indian Affairs, travelling from Labrador to almost the Yukon, crossing James Bay four times, twice in an open boat, from Port Albany to Moose Factory. He is not strongly impressed with the financial success of a railway following the Abitibi or Frederick House Rivers to Moose Factory on James Bay.

He was for a number of years in the electrical contracting business as head of the firm of Ramsden & Roxborough. Among some of the large works done by his firm were the new King Edward Hotel and Dominion Shipbuilding plant.

In addition to these activities Mr. Ramsden was Alderman for Ward 3 in the City of Toronto for seven

years and one of the Controllers of the City in 1920. He was three years on the Public Library Board.

Mr. Ramsden is a life member of Ashlar Masonic Lodge and also a life member of St. Paul's R. A. Chapter. He is a member of the Sons of England and Past Master L.O.L. 657. While belonging to several fraternal associations and societies he has never made a hobby of it, and while attending one of his own lodge meetings he has been known to be coupled with the visiting brethren in responding to the toast.

The new commissioner is taking his duties seriously and becoming imbued with the spirit that prevails in Hydro matters for public service.

We wish to extend a hearty welcome to Mr. Ramsden, feeling assured that all efforts by him in his new work will strengthen the hand of the chairman and further the great principle of co-operation, in placing the Hydro-Electric Power Commission of Ontario on an even firmer foundation.

History of the Hydro-Electric Power Commission

No. 4.

The Commission and its Relation to the Municipalities

THE municipalities having shown their willingness to join together for mutual assistance in obtaining electrical energy from Niagara Falls, the Government determined to give them the opportunity they sought. Under authority of an Act of the legislature, a second commission, which became the permanent Hydro-Electric Power Commission of Ontario was appointed in May, 1906. Hon. Adam Beck was appointed Chairman of this Commission, the other members being Hon. John S. Hendrie (afterwards Lieutenant-Governor) and Cecil B. Smith, civil engineer. Mr. Smith resigned a year afterwards, owing to the demands of his professional business and was succeeded by Mr. W. K. McNaught, who remained a faithful member until his death on February 2nd, 1919. The Hon. John S. Hendrie was succeeded by the Hon. I. B. Lucas, who served up to his retirement in 1921, when he was succeeded by Mr. Fred R. Miller. Mr. Miller held office until his decease on August 30th, 1922. Mr. J. G. Ramsden was appointed to succeed Mr. Miller about the middle of January, 1923. After the death of Mr. McNaught the work of the Commission was carried on by the two remaining members, viz.: Hon. Sir Adam Beck and Hon. I. B. Lucas, until after the election in the

Fall of 1919, when Colonel the Hon. D. Carmichael was appointed Government representative on the Commission, which position he still holds.

It was found that the previous legislation governing the working of the Commission was inadequate for its proper operation, so at the session of the legislature in 1907 it was revised. The Act of 1907 became the Charter of the Hydro-Electric Power Commission of Ontario, and created a body corporate under that name. This Act of 1907 had been amended from time to time to provide for extensions to the operations of the Commission not originally provided for, and also to facilitate its working.

The Commission consists of three members appointed by the Lieutenant-Governor-in-Council, one of whom shall be a member of the Executive Council. The Lieutenant-Governor may appoint one of the members to be Chairman of the Commission. Every person appointed to the Commission shall hold office during pleasure, and the Lieutenant-Governor-in-Council, upon the death, resignation or removal from office of any member of the Commission, may appoint some other person to fill his place.

The Commission may, by report to the Lieutenant-Governor-in-Council, designate any lands, waters or waterpowers, including the plant pertaining to such property, which in the opinion of the Commission should be acquired or leased. On such report the Lieutenant-Governor may authorize the Commission to acquire the same by purchase, lease or otherwise. The Commission may acquire or construct plant and works for the generation, transmission, distribution and supply of electrical power to persons, firms or corporations, and enter into contracts with such persons, firms or corporations for the delivery of such electrical power. When called upon by the Lieutenant-Governor-in-Council, the Commission shall investigate waterpowers and report as to their capacity and value.

When a municipality wishes to consider the advisability of obtaining electrical energy from the Commission, it must, through its proper officers, ask the Commission to report. After the receipt of such request a study is made of the requirements of the municipality to show the probable load required, and if desired the cost of a distribution system for its delivery to the consumers. Estimates are prepared of the cost of the power to the municipality together with its share of liability to the Commission for the cost of construction and capital charges on the same, to deliver that power. If the applying council considers that the municipality would be benefitted by the service, a by-law is prepared and a vote of the electors is taken thereon. If money is required by the municipality to be spent on its distribution system for the delivery of the power within the municipality, a second by-law is prepared covering the amount, which is also subjected to a vote of the people. This second by-law may, if desired, be submitted to the electors at the same time as the vote is taken on the first, which is commonly known as the enabling by-law. Having carried these two by-laws the municipal council then has authority to enter into an

agreement with the Commission for the delivery of the power, and to raise by debenture issue the money to provide the distribution system. The agreement between the Commission and the Municipality must be submitted to the legislature at its next session for ratification.

The Commission agrees to construct transmission lines and other works for the delivery of electrical energy to the municipality, and to deliver the power as required. Up to the point of delivery to the municipality the Commission holds the position of a company supplying power to the municipality. It obtains the electrical power either by generating or by purchase from generating companies, and by its system of transformer and interswitching stations and transmission lines delivers that power to the municipality. It remains with the Commisison to bear the cost of all construction for the delivery of the power and the cost of operating, maintaining and renewing it so that it will at all times continue in the best possible condition and give as near as possible an uninterrupted supply of power.

Such monies as are required by the Commission on account of construction are supplied by the Province out of appropriations for the Commission. These monies being obtained by the Province from the sale of bonds, the Commission is required to reimburse the Province according to the nature of the bonds. The Commission must each year pay to the Province, interest on all monies advanced to it on account of construction, together with an amount for sinking fund for the retirement of the bonds. By this system of financing and by maintaining all of its works in the best possible condition, the Commission will in time operate a plant that will be debt free and at the same time equal to the best standards of construction and operation then existing.

The municipality as the customer of the Commission has by its portion of the agreement undertaken those things that insure the success of the whole undertaking. As a partner with the other municipalities it pays to the Commission the cost to the Commission of all power purchased by the Commission for its use, and its proportionate part of the cost of delivering that power. The municipality also assumes a liability for its proportionate part of all monies advanced by the Province to the Commission on account of construction for the delivery of that power. Although the Commission uses money obtained by the sale of bonds guaranteed by the Province of Ontario, yet by their agreements with the Commission the municipalities give a second guarantee covering these bonds.

The Commission therefore holds the position of a trustee which is unique, investing money obtained by the Province of Ontario for the benefit of the municipalities. Account must be made to the Province of all money advanced by it, and at the same time the municipalities have the privilege of inspecting the Commission's books in their own interest. Although appointed by the Province and using funds advanced by it, the Commission is nothing more than a board acting on behalf of the munici-

palities who are in reality the parties most interested. The Province is the banker and the municipalities are the borrowers while the Commission is given the supervision of the money loaned.

In the cost of power as billed to them by the Commission, the municipalities pay their proportionate part of the interest and sinking fund to be paid to the Province on account of the funds advanced by it for construction to serve those municipalities. The bonds issued by the Province will therefore in time be redeemed out of money supplied by the municipalities. Until these bonds have been redeemed the Commission retains a lien on all construction made by it and is the nominal owner. After the debt has been paid, the municipalities then become the sole owners of all construction and the interest of the Province in that portion of the Commission's work automatically ceases. According to the present legislation there will then exist a system of municipal ownership of electrical utilities in its full meaning. The municipalities are on their own account paying for the distribution systems within their corporate limits, while as members in a big partnership, through a board of trustees they are paying for the generating and transmission systems to serve them. When these debts have been paid, they will be the owners, still partners in the one great scheme.

The service is given to the municipalities at cost. The Commission is not allowed to make a profit, nor can it operate at a loss. At the end of each year an adjustment must be made and all of the expenses incurred in that year on account of the delivery of the power must be apportioned among the municipalities to show the actual cost of the power taken by each municipality during the year. It is not until after the end of each year and the adjustment has been made that the municipalities know the actual amount of the cost of their power. The agreements require that they shall pay this cost in twelve monthly instalments, each depending upon the amount of power taken in those months. In that the actual cost cannot be made up until after the year is completed it is impossible to render monthly bills according to the strict interpretation of the agreement. The monthly bills are therefore worked out on what are known as interim rates. These rates are based on the operating conditions of the previous year or else on an estimate of the municipality's requirements. After the end of the year when the adjustment has been completed and all costs have been apportioned to the various municipalities, the differences between the actual costs and the amounts paid according to the interim rates are compared. The municipalities are then rendered debit or credit statements as the case may be. Those municipalities that are found to have overpaid the actual cost of power are reimbursed by the amount overpaid, while those that have underpaid make up their shortages in paying what is commonly known as the thirteenth power bill.

The distribution of the power to the various classes of consumers rests with the municipality. All expense on account of construction within the

corporate limits must be financed by the municipal corporation. The Power Commission Act rules that all money borrowed by the Province or any municipality for the construction of transmission or distribution systems or other works provided for in that Act shall not affect the borrowing powers of the Province or the municipality. The framers of the Hydro Constitution saw that the slogan "Service at Cost" was to mean service at cost to the ultimate consumers. The municipal systems were to be self-supporting and to operate in such a manner that they would require no assistance out of the general taxes. It was therefore provided that the municipal electrical systems be kept as separate departments of the municipalities, and provision was made for the election of municipal commissions to manage them. The municipal electrical commissions are the custodians of the municipal electrical systems and have the supervision of their operation and finances. It is impossible, therefore, for finances of the electrical systems to become mixed up with the others of the municipalities and the electrical departments cannot be made contributors to benefit the general taxes.

The consumers receive service at cost. The municipal systems must not be operated for a profit. Each municipal system must at the end of each year make a statement of its finances for that year, showing the classification of all receipts and expenditures. The amounts of expenditure given in these annual statements are apportioned among the various departments of service of the electrical department, viz.: lighting, power, street lighting, etc., to show whether these departments are on a proper cost basis, or whether surpluses or deficits are being made. If it is found that a department is making a surplus, the rates are reduced. Similarly a deficit justifies an increase. This rule applies to all consumers excepting the municipality itself. If it is found that the street lighting, waterworks pumping or similar service has made a surplus or deficit, the amount is refunded or collected and the rates are changed to put those services on a cost basis.

In order that the municipal commissions would not be faced with the problem of laying out a system of accounts that would give the necessary detail regarding the municipal system's finances, the Hydro-Electric Power Commision was given the power to lay out a system for them. The Hydro Commission was also given the privilege of taking such information as it desired from those books and publishing it in its reports. The Hydro Commission having access to the accounts of the municipal system, it is in a position to study those accounts and satisfy itself that the consumers are paying no more than their just portion of the total operation. The rates used by the municipal systems are also subject to the approval and control of the Hydro-Electric Power Commission. It can, therefore, if it considers the facts shown by the municipal statement warrant it, recommend that the rates in the municipality be adjusted to conform with the cost of service.

In a system extending over a vast area and serving practically all of the

cities, towns and villages within reach of its lines, it is to be expected that the work of the Commission would include more than the operation of that system and supervision of the municipal systems' accounts and rates. The systems have continually to deal with new problems for they are all growing, taking on more consumers and more load. Extensions are required, present construction has to be changed and increased and materials and equipment are to be bought. It is only the larger cities that can keep a staff of employees competent to look after all details. The other municipalities must have someone to advise them and assist them in their problems. The Commission has made provision for such cases, and the municipal systems are enabled to get any such service which is also rendered on a cost basis.

Up to this point we have treated only of the Hydro-Electric Power Commission in its relation to municipalities when the latter are considered as taking action covering the whole of the corporate limits. In police villages we have communities having certain powers of themselves, yet being dependent upon the corporations of the townships in which they are located regarding other matters. Provision is therefore made for police villages to enter into agreements with the Commission for a supply of power under conditions that are peculiar to themselves.

In its relation to the Commission the Police Village assumes the status of a municipal corporation and can contract for a supply of power if the property owners within its limits give a favorable vote. The township or townships in which the police village is situated must by a by-law of its council and not submitted to a vote of the electors, raise by a debenture issue sufficient money to finance the construction in the police village. The property within the police village takes the whole responsibility for the bonds or debentures issued and any tax levy that may be made on account of them must be borne by the police village alone. Upon the completion of the distributing system and placing it in service all responsibility in operation and handling of finances rests with the police village who is then a partner sharing with the other municipalities in the rights and privileges as provided by the Commission.

It is also provided that in cases where power service is desired outside the jurisdiction of any municipal corporation, the consumer and the Commission may enter into an agreement to supply that power. Under this arrangement service is supplied to manufacturers, railways and other companies that would otherwise be deprived of service. Any profit resulting from services of this nature are retained by the Commission and applied towards the maintenance and operation of its works, thereby working for the general assistance of all of the municipalities.

The powers of a municipal corporation cease at its limits and it has not of itself any authority to spend money on any kind of construction or to collect revenues outside those limits. In order that the benefits of the service might be extended to people or manufacturers located outside the munici-

pality, special provisions had to be made. It was provided, therefore, that any township having received a petition from the people asking for service can take up the question in either of two ways. On the authority of the petitioners taking service the township can enter into a contract with the Commission for a supply of power, and by fixing the limits of the area to be served submit the question to a vote and raise the money required for construction, making the area responsible. Under this plan the township becomes a partner in the whole scheme for the benefit of the voted area, the rest of the municipality being unaffected. Instead of the township undertaking the distribution of power, it may enter into an agreement with the municipality adjacent to it to have the latter undertake the service required. In this case the serving municipality is granted such rights as are necessary for the satisfactory operation of the system required, making the property holders financially responsible.

This phase of the work naturally brought up the question of extending farther out to more sparsely settled districts and ultimately to farms and lighting along country roads. This brings up a new field with conditions absolutely different from those in urban and suburban districts. Instead of the township undertaking the distribution of the power or having some other municipality do it, it is taken care of by the Commimssion itself under an agreement with the township, the cost of construction being guaranteed by the users who are all required to sign long term agreements. Since the proportionate number of services is low in such districts, the cost and the rates per service would be such as to prohibit such extensions being made. In order that the benefits of Hydro might be given in the more convenient parts at reasonable rates the Ontario Government adopted the policy of advancing part of the cost of construction in rural districts.

Where power is required for road or street lighting the cost of all construction for street lighting only is carried by the township. Such street lights when installed receive their power from the rural distribution system and are operated as part of it, the township collecting the cost from the ratepayers of the district served and remitting the same to the Commission.

Although the rural consumers may each be considered as holding individual agreements with the Commission, yet each rural district is treated as a separate municipality and without regard as to the direction in which it is served. All consumers of the same class are served at the same rates whether near the distributing station or at the most remote limits. Service is supplied at cost as in the urban municipalities, and any surplus or deficit in the finances of the district are reflected back to the consumers in an adjustment of their rates.

With a system involving a great expenditure in capital and serving almost every imaginable kind of load, every precaution must be taken to protect that system from any kind of avoidable accident. All plant and equipment, distributing or using electrical energy is therefore subject to

the approval of the Commission. In enforcing a high standard of construction, the protection automatically extends also to the persons and property of the users.

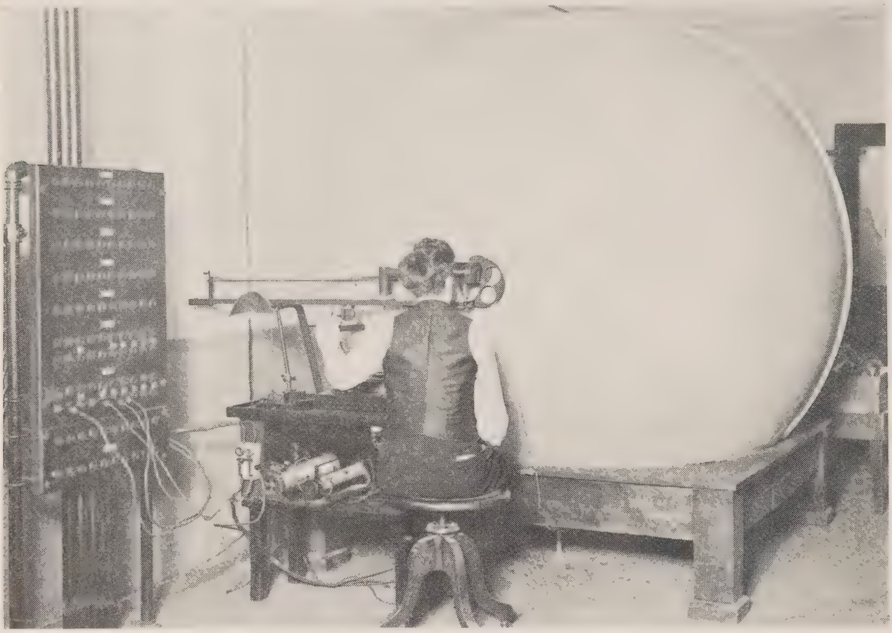
The inspection of inside work had heretofore been left to the insurance underwriters. The service given by them extended only to the large towns. It was recognized that the service should reach every point where electrical service is given. The Provincial Government, therefore, passed the requisite legislation and established an Electrical Inspection Department. The supervision of this Department is placed with the Commission.

The inspection and approval of inside wiring and electrical installations necessitated extending the work of the laboratory previously established by the Commission, to include approval work. Another article herein gives a brief outline of the work carried on in it. This is another service that has been inaugurated for the benefit of the municipalities, any special work required by them being given at cost.

Such is the organization of the greatest municipally owned electrical co-operative organization in the world. It has its existence for the benefit of those who use it, and those users know that in their bills for service they are paying only their share of the cost of that service and are in no way contributing to the coffers of a corporation controlled by a few individuals.

The Development and Function of the Laboratories

THE department was organized in 1913 when equipment for testing lamps was installed in Toronto Terminal Station. Shortly afterwards work was begun on the Service Building adjoining the Toronto Terminal Station and upon its completion, the Laboratory occupied the northern portion of this building. Several pieces of testing equipment, which had been purchased from time to time, were brought in from various parts of the system and installed in this building. Among these were the 300,000 volt testing transformer from Dundas, the oscillograph, a considerable number of portable meters, and the lamp testing equipment from the Terminal Station. The department was then organized to include three divisions: The Lamp Testing division, the Meter and Standards division, and the High Tension and General Testing division. From that time, there has been a gradual expansion, and equipment has been added from time to time and additions made to the staff in order to provide for the ever increasing volume and variety of the work which the depart-



Integrating Sphere Photometer.

ment has been called upon to perform. In 1918 a considerable extension was made to the Service Building, and the whole of the older portion given over to Laboratory work. All of this space is now being used for Laboratory purposes.

Since the first organization a Photographic Section has been added to take care of photography and blueprinting, and an Engineering Materials Section to take care of testing of a non-electrical nature, including physical and chemical tests.

In connection with the enforcement of the Electrical Inspection Regulations, the Approval Laboratory was organized in 1918 to carry on tests and inspection of electrical material, devices and fittings which are required by law to be approved by the Commission before being sold in the Province of Ontario.

The present organization includes the following divisions:—Tigh Tension and General Testing, Meter and Standards, Photometric, Physical and Chemical, Photographic, and Approval.

The present functions of the Laboratory are fourfold:—

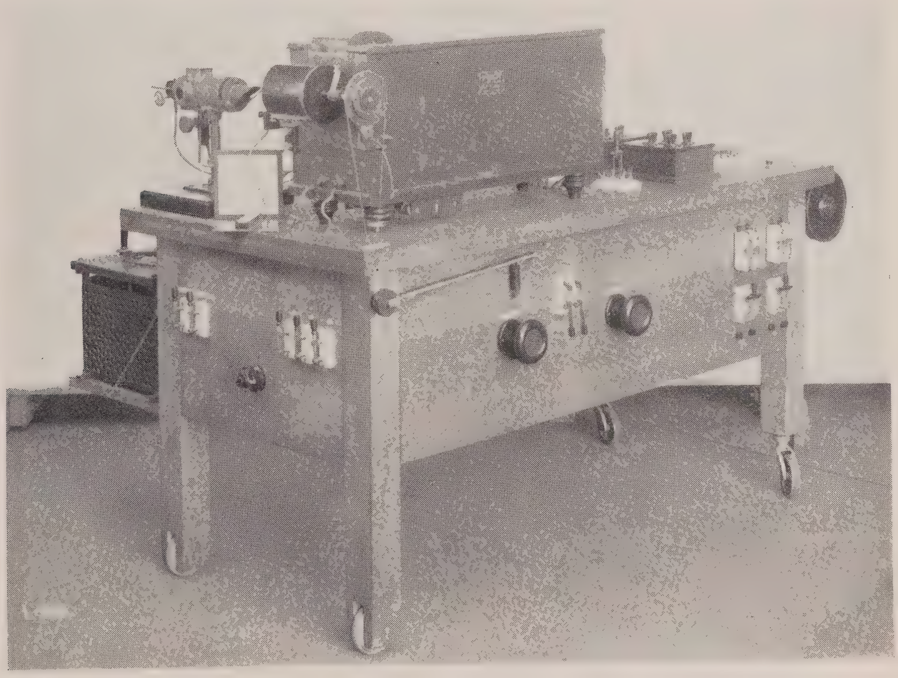
1. Testing.
2. Inspection.
3. Approval Testing.
4. Research.

The testing work of the department includes quality testing of all kinds of materials—electrical and non-electrical; quality and efficiency tests on electrical machinery, apparatus, devices and materials, such as generators, transformers, incan-

descent lamps, insulators, insulating material, transmission line construction material; paints and protective coatings; oil, gasolene; steel and all kinds of metals used in construction work; cement and concrete materials, etc. Whenever possible all materials and apparatus are purchased under specification, and the testing work necessitated by these specifications is done by the Laboratory. Periodic tests are also made on many types of materials in permanent use, such as transformer oil, linemen's rubber gloves, etc., in order to maintain the quality of the materials in service.

A considerable amount of testing work is also done for parties outside the Commission, who may require expert testing service. The very large range of service required by the Commission has rendered necessary the installation of equipment and the training of a staff for a wide variety of testing work, which facilities are thus made available to the public.

The inspection work of the Laboratories includes engineering materials of all kinds. A very large volume of structural steel for power houses, bridges, etc., reinforcing steel for concrete, steel rails, penstocks, turbine valves, gates, etc., have been inspected in connection with the various construction jobs. This inspection is carried on both in the factory where the fabrication of the material is checked up in detail, and in the field where the erection of the structure is followed closely by the in-



Oscillograph.

spector. Samples of the materials are also tested for strength, in the Laboratories. Expert engineers and inspectors are furnished by the Laboratories to the Engineering and Construction Departments, and they carry on this inspection work. In this way a close check is kept upon the quality of materials entering into the structures and much time, inconvenience and expense is saved by the correction of factory mistakes in fabrication before the material is forwarded to the field.

A similar service is rendered in connection with concrete materials. When a new power project involving concrete construction is proposed, the Laboratory is instructed to recommend suitable sources of material, such as sand and stone. Surveys are made, materials collected and tested in the Laboratory. As a result of these tests recommendations are made regarding suitable sand and gravel pits for the job in question, and also regarding suitable proportions for mixing the cement, sand and stone to obtain the necessary strength of concrete. An inspector is furnished by the Laboratory whose duty it is to see that the materials are properly proportioned throughout the job; he makes continuous tests on the sand and stone, and also takes from the mixer each day, test specimens of the concrete and either tests them in the field or forwards them to the Laboratory. In this way a continuous record of the quality of concrete in any job is obtained.

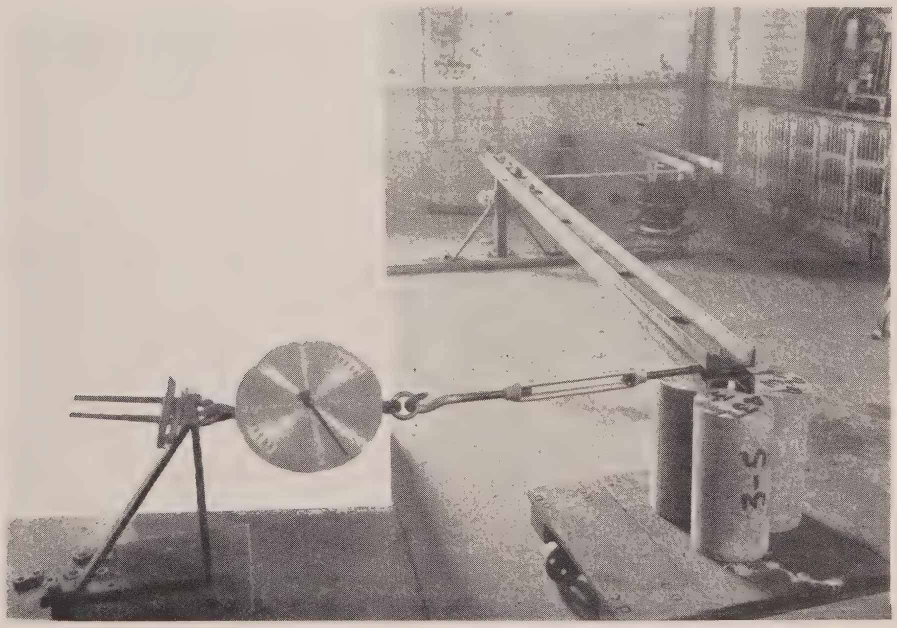
The third division of the activities of the Laboratories may be designated Approval Testing. This has to do with the enforcement of the Electrical Inspection Regulations referred to above. The Power Commission Act provides that no electrical material, devices or fittings may be sold or used in Ontario unless the design and construction of the same has been approved by the Commission. In order to approve these devices it is necessary that complete tests be made upon them, and the Approval Laboratory was organized in 1918 for this purpose. This section is kept very busy testing and inspecting all sorts of electrical devices, apparatus, materials or equipment used in the province. This work at present does not include equipment for very high voltages, only in a few cases has any equipment for use on circuits of over 600 volts been tested. The routine of the Approval Laboratory provides not only for testing representative samples of the devices submitted in order to compare them with the standards, but also for periodic inspection of approved materials and devices, either in the factory, in the Laboratory, or elsewhere. In this way it is possible to ascertain whether or not manufacturers of approved equipment are continuously supplying their products in accordance with the standards required.

In this work the Laboratory works in co-operation with the Electric Inspection Dept., also with the manufacturers who have representatives on a Committee which passes upon the Laboratory reports. Although the legal authority of the Commission in this work does not extend beyond Ontario, yet the approval of the Commission is accepted in some other

parts of Canada and full co-operation is maintained between the Laboratories of the Commission and inspectors all over the country. The Commission also co-operates with Underwriters' Laboratories of the United States in this work, and receives from them valuable assistance in addition also to rendering them assistance.

The fourth division of the work of the Laboratories is included in the general term research. Studies are continually being made of problems arising in connection with the construction or operation of the Hydro Systems and include electrical, physical and chemical problems. The enumeration of a few of these would occupy too much space and only a general indication will be given of the type of problems considered.

Among the electrical problems those connected with disturbances on the system, such as lightning disturbances, insulator breakdowns, transformer troubles, surges on the lines due to the above causes, may be mentioned. These studies are both theoretical and experimental, the preliminary theoretical studies being made in the Laboratory and the experimental studies in the field at the point where the trouble has occurred, whenever this is necessary. In connection with this work engineers from the Laboratory have been to all parts of the system investigating unusual conditions and recording the data so obtained for the purpose of assisting in future investigations as well as for the purpose of clearing up the trouble which has occurred. Many problems have arisen in connection with the de-



Torsion Test on Insulator Support for Disconnecting Switch.

sign of power stations, transmission lines, etc., and extended and lengthy investigations have been made in the Laboratory to obtain data for the engineering and construction departments to assist them in the construction and design of these works. In several cases these investigations have resulted in original contributions to the literature of electrical engineering.

A large amount of work of an original character dealing with methods of proportioning concrete has also been done in the Laboratory. The results of these investigations have been published in Canadian and American technical journals and requests for information have been received from all parts of the world as a result of these articles. Some of them have been translated into foreign language.

The equipment of the Laboratory for electrical testing is probably the best in Canada. The Engineering Materials Laboratory is also well equipped for a wide variety of testing. Both equipment and staff are available to all who may be in need of expert testing or research service. The Laboratories are open at all times during office hours for the reception of visitors who may be interested in seeing the equipment.

ANNOUNCEMENT

"THE HYDRO LAMP"

(Bulletin)

We take this opportunity of announcing that the "Hydro Lamp" is well away on its career. It is here to stay, and from now on the circulation should increase monthly until finally 300,000 copies will be distributed.

We wish also to announce that the Hydro Commission are absorbing one-half of the cost of producing these Bulletins, and Municipalities entering into the proper spirit of co-operation in the distribution will be asked to pay only half of the cost for the number of Bulletins they are able to distribute.

These Bulletins will also be sent to Municipalities with a consumer list of not more than 300 without rendering a bill, and we ask that the greatest care be exercised in securing the most effective distribution in Municipalities where these Bulletins are sent on that basis. They cost real money and they should not be wasted, and a great deal of good can be done by using good judgement in placing them in the hands of the consumers.

We would further ask that you use real effort to spread these Bulletins among the consumers in your Municipality, and not let the fact that you are not paying for them directly influence you in neglecting to arrange for distribution.

How many copies do you wish per month?

Yours for co-operation,

HYDRO-ELECTRIC POWER COMMISSION OF ONTARIO

Household Electric Refrigeration

Investigation Shows Great Possibilities for Load Building, Better Servicing Facilities Must be Provided, Camparison of Costs

By T. I. JONES,

General Sales Agent Brooklyn Edison Company, Inc.

THE potential value of the household refrigeration load has long been appreciated by central-station companies, but because of the high first cost of reliable machines, together with other problems of selling and maintaining the equipment in satisfactory operation, the introduction of this appliance has been comparatively slow. With a view to ascertaining marketing methods and making recommendations for increasing the sale and use of residential sizes of electric refrigerators a survey has been made of the present status of this business as it applies to the central-station industry.

One of the principal reasons why the electrically operated refrigerator has not achieved wider application and a larger market is because of the lack of organized methods for servicing. Like the automobile or any other highly developed piece of mechanism, a reasonable amount of care and supervision in operation is necessar to produce the best results. Unless some definite method of maintaining the machine after it is purchased is devised and effected, satisfactory results are difficult to obtain.

Refrigerating equipment now available is generally marketed in two ways. Either the mechanical apparatus is supplied and sold entirely separate from the box, or the mechanical equipment and the box are manufactured and sold as a unit.

To ascertain correctly the practical operation of the modern household electric refrigerator as recently developed, a complete list of all sales of two of the principal types of machines within a given territory was obtained from the manufacturers, and from this list names were arbitrarily picked and a letter sent to each asking answers to the following questions: "What is the name of electric refrigerator?" "How long have you used it?" "Has it operated satisfactorily?" "What trouble have you experienced, if any?"

The 115 replies to this questionaire which were received may be summarized as follows:

1—Average time in use.................19 mths.
2—Number in operation generally satisfactory 95

* From a paper presented at the forty-first convention of the Association of Edison Illuminating Companies at White Sulphur Springs, W.Va.

Number in operation with minor troubles 12
Number in operation generally unsatisfactory 4
Number entirely discontinued 4

3—Nature of troubles: Thermostat control out of order, motor trouble, odor of gas, leak in brine tank, belt had to be replaced.

Some of those who reported minor troubles have had the machine in use for two or three years. The manufacturers state that material improvement has been made in the refrigerator during the past year, and an analysis of the replies of those using machines bought within the past twelve months seems to show general satisfaction with their operation.

It would seem from an analysis of these replies that the electric household machine has been sufficiently developed to warrant practical use with reasonable care of the machine. It cannot operate without maintenance, and this care is essential if the electric household refrigerator is to be in constant use.

If one were to list the advantages and disadvantages of the electric household refrigerator as at present developed, they might be recorded as per the list below:—

Advantages

1—Better sanitary conditions.
2—Dry cold.
3—Pure ice for drinking purposes.
4—Quantities of food can be stored.
5—Economy in lessening food spoilage.
6—Convenience.
7—Saving in labor.
8—Does away with the ice man.
9—No uncertain time of the delivery of ice.

Disadvantages

1—Present high cost of original equipment.
2—Uncertain servicing.

Enlarging on one of the advantages indicated, a study made by A. M. Greene, Jr., professor of mechanical engineering at Rensselaer Polytechnic Institute, Troy, N. Y., is significant. Harmful bacteria become inactive when temperature is less than 44 deg. F. dry air. The temperature in the average domestic ice box does not usually drop below 50 deg. F., so that bacteria is still active and food spoils. Professor Green's test was made on 250 domestic ice boxes, and showed that only 14 per cent. of them operated with a temperature of less than 45 deg. F. "This demonstrates," says the professor, "that ice is not a reliable means of preserving food." That this has long been recognized is shown by the development of our present system of cold-storage warehouses using refrigerating machines which remove the heat and produce a dry temperature, wherein bacteria are rendered dormant and foodstuffs kept and maintained in edible condition for indefinite periods.

Comparative Costs.

The comparative cost of refrigeration by means of ice and by means of mechanical operation has, of course, a strong bearing on the marketing of the electrical machine.

TABLE II.—COMPARATIVE ANNUAL COST OF OPERATING ELECTRIC HOUSEHOLD REFRIGERATORS AND ORDINARY ICE BOX.

	Ice Refrigerator	Machine No. 1	Machine No. 2 Type A	Machine No. 2 Type B	Machine No. 3
Cubic contents, feet	6	6	6	5	7.5
Cost of cabinet or ice box	$100.00	$100.00	$100.00	....	....
Cost of refrigerating machine	....	225.00	295.00	....	....
Cost of cabinet and machine	....	....	....	495.00	550.00
Total cost of refrigerator complete	$100.00	$325.00	$395.00	$495.00	$550.00
Operating Cost:					
Interest on investment	$ 6.00	$19.50	$23.70	$29.70	$33.00
Depreciation	10.00	32.50	39.50	49.50	55.00
Operating cost	42.00	30.00	30.00	30.00	30.00
Total Annual Cost	$58.00	$82.00	$93.00	$109.20	$118.00
Rate of interest, per cent.	6	6	6	6	6
Estimated rate of depreciation, per cent.	10	10	10	10	10
Estimated annual consumption lb. and kw.-hr.	7,000	600	600	600	600
Estimated rate paid, cents per 100 lb. and per kw-hr.	60	5	5	5	5

Cubic contents, feet	10	10	10	9	8.5
Cost of cabinet or ice box	$150.00	$150.00	$150.00	....	....
Cost of refrigerating machine	....	250.00	295.00	....	....
Cost of cabinet and machine	....	....	....	595.00	650.00
Total cost of refrigerator complete	$150.00	$400.00	$445.00	$595.00	$650.00
Operating cost:—					
Interest on investment	$ 9.00	$24.00	$26.70	$35.70	$39.00
Depreciation	15.00	40.00	44.50	59.50	65.00
Operating expense	54.00	35.00	35.00	35.00	35.00
Total Annual Cost	$78.00	$99.00	$106.20	$130.20	$139.00
Rate of interest, per cent.	6	6	6	6	6
Estimated rate of depreciation per cent.	10	10	10	10	10
Estimated annual consumption, lb. and kw-hr.	9,000	700	700	700	700
Estimated rate paid, cents per 100 lb. and per kw.-hr.	60	5	5	5	5

Table I, shows that for an apparatus of 6 cu. ft. capacity the annual cost of ice refrigeration is $58, as compared with a cost for electric operation with a kilowatt-hour rate of 5 cents, varying between $82 and $118, in accordance with different types of machines. This comparison is on the basis of ice at 60cents per 100 lb., and takes into consideration interest on investment and cost of depreciation in both cases. For a 10-cu. ft. outfit the comparison is $78 for ice as against a variation of $99 to 139 for electric operation.

Considering the saving in food and the greater sanitary and convenience advantages of electric operation, this

operating expense is by no means prohibitive. The difficulty will lie, therefore, not so much in the operating cost as in the large investment required for electric refrigeration, and before this appliance can come into general use its first cost must be materially reduced. With quantity production this difference will tend to disappear.

A conference with the executives of the refrigerator manufacturers developed an interest by the manufacturers and an agreement on their part to reduce the price of the machines if the output could be materially increased.

Value of Load

We now come to the value of the domestic refrigeration business to the central-station companies of this country. Table II shows the comparison of revenue derived from household electrical appliances. The kilowatt-hours used are based upon a record of actual use. If a special 5 cent rate, as has been suggested from some sources, were made for refrigeration business, this would reduce the revenue figure shown in the table from $64 to $40.

This table indicates rather clearly the desirability, other things being equal, of making a serious attempt to develop this business. This will be further emphasized in our minds if we take into consideration two further facts:

1. No special additional investment is required to be in readiness to serve this type of apparatus as is the case with ranges, for instance.

2. The average maximum demand for household refrigeration purposes not being much more than 0.25 k.w.,

Table II.—Revenue from Household Electrical Appliances

	Maximum Demands Watts	Annual Consumption Kw. Hr.	Rate Per Kw. Hr.	Annual Revenue	Annual Revenue per Kw. Demands
Waffle Irons	600	30	8c.	$ 2.40	$4.00
Grills	500	34	8c.	2.72	5.44
Heaters (radiant)	600	42	8c.	3.36	5.60
Toasters	500	37	8c.	2.96	5.92
Washing Machines	300	25	8c.	2.00	6.67
Percolators	400	42	8c.	3.36	8.40
Irons	600	72	8c.	5.76	9.60
Ironers (electrically heated)	3,000	360	8c.	28.80	9.60
Vacuum Cleaners	200	27	8c.	2.16	10.80
Radiators	600	96	8c.	7.68	12.80
Ironers (gas heated)	300	60	8c.	4.80	16.00
Heating pads	50	15	8c.	1.20	24.00
Fans	50	16	8c.	1.28	25.60
Sewing Machines	50	17	8c.	1.36	27.20
Lamps (portable)	150	60	8c.	4.80	32.00
Ranges	2,500	1,500	8c.	120.00	48.00
Refrigerators	300	800	8c.	64.00	213.33

and the number of kilowatt-hours used being comparatively large, the load factor of this business, in comparison with other household service, is exceptionally high and attractive.

The criticism, of course, will be made that the central station now has the greater portion of the ice-manufacturing business, and to encourage the sale of energy for household electric refrigerators will be merely transferring the income from one customer to another. While it is true that the greater bulk of our artificial ice manufacturing is now done by central-station power, it must also be borne in mind that the average rate to the central station for this service (usually high-tension) does not exceed 1¾ cents per kilowatt-hour, while the average rate (low-tension) for the revenue estimated in Table I is 5 cents per kilowatt-hour, showing a material margin in favor of the low-tension service. It is further pointed out that with electrical refrigeration the use will be much more extended than with local use of refrigeration by ice.

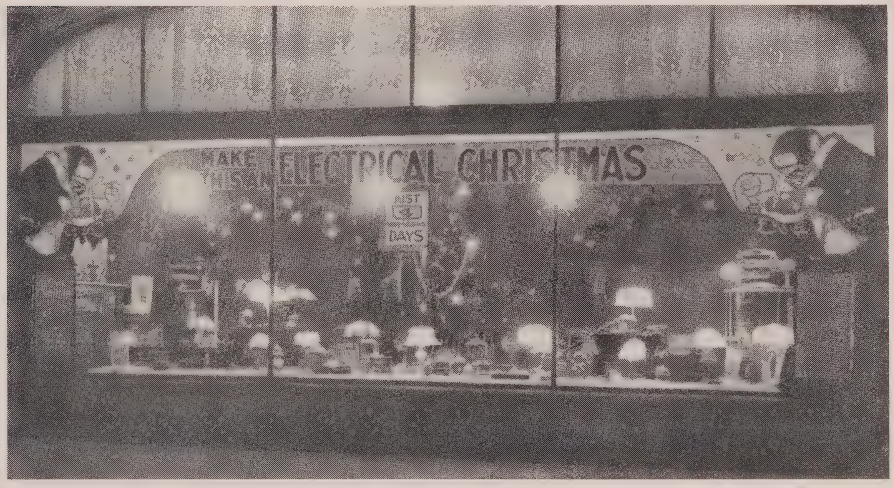
Recommendations

In view of the facts here presented and their bearing upon the development of additional attractive business of the revenue-producing type, the following recommendations are made:

1. That the central station encourage the sale of the electric household refrigerator as at present developed, it being understood that with this encouragement the manufacturers guarantee proper servicing conditions.

2. That a committee from this association or an individual investigator be appointed to continue the investigation of this subject, reporting from time to time the development of the appliance and calling to the attention of the apparatus manufacturers any general criticisms on their machine and service.

—Electrical World, Nov. 4, 1922.



Window Display, London Hydro Shop.

Bread and Butter Economics

By SIR LEO CHIOZZA MONEY

DOUBTS may reasonably be entertained as to the forms of ownership and control best suited to the production and distribution of commodities, such as food, or clothes, or houses. There can surely be no doubt, however, that when it is a matter of controlling services which are essentially public in their nature (such as water supply, sewage systems, road maintenance, street lighting, gas and electricity supply) *THE COMMUNITY SHOULD TAKE CHARGE.*

Such undertakings are essentially non-competitive and monopolistic, and that being so they ought not to be resigned to the control of trusts.

This is not to attack the existing companies which own undertakings, for if the community has not the sense to serve itself, it ought to thank and not to blame capitalists who do what it leaves undone. Better a tramway company than no tramway; better a council tramway than a trust tramway.

Thus also with the all-important subject of electricity, which throughout the world is passing into public hands.

The latest figures relating to electricity prices show how well public electric undertakings are serving us. The Stoke Newington Borough Council have reduced the price of current since last June from 7d to 6d for lighting, and from 2½ to 1½ for domestic heating and cooking. The St. Pancras Borough Council are doing better still. They have reduced their prices for lighting from 6d to 5d per unit, and for power and heating from 1½d to 1d per unit. This is not done at the expense of the ratepayers. On the contrary, at the lower prices the profits will be large and will reduce the rates.

Thus, again, at Hackney; in spite of low charges, a profit of £25,000 has been earned in the last year.

When I served on the Coal Commission I took some pains to get placed before that flouted body, whose work was not allowed to give prosperity to the nation, the remarkable facts as to electricity in the country as a whole.

Sworn and uncontradicted evidence showed that at every point the local authorities controlling electricity in the public interest did better than the private elecric companies. The public authorities worked with smaller capitals per unit, had smaller working expenditures, spent less on officials, and charged the public less for electricity.

THE DIFFERENCE IN PRICES WAS ACTUALLY 60 PER CENT. IN FAVOR OF THE PUBLIC BODIES.

I hardly know why it should be necessary to point out these very obvious things. Have not Londoners, for instance, noticed that when the trust trams and the trust omnibuses come in contact with the London

County Council trams they have to reduce their fares? Have they not observed the difference in length between a penny ride on an L.C.C. tram from, say, Blackfriars, and a penny ride on a London General omnibus on roads where there are no public trams?

—Exchange.

* * *

Ten "Donts" in Using Electric Equipment

To minimize the possibility of accidents or fires from electrical causes, City Electrician Israel Lovett of Omaha, Neb., has published precautions against careless handling of electrical equipment, extracts from which as published in the Electrical World, are given in the following:—

Don't fail to insist that your electrical contractor secures permit and inspection for any new electrical wiring. You help to pay the salaries of the inspectors; why not have something to show for your money?

Don't use pennies for fuses. There used to be a practice of hanging a monkey wrench on the safety valve. This has become unfashionable.

Don't use or handle electrical appliances such as vibrators, heaters, etc., while sitting or standing in the bath-tub.

Don't leave the electric flatiron connected to the circuit and go to use the telephone, visit with the neighbors or to call at the grocery. It costs $100 for the fire department to make a "run" even for a smoking ironing board.

Don't use paper shades or other inflammable materials or decorations about electric lamps.

Don't use lamp cord wiring in your homes. It is unsightly and unsafe. The underwriters' committee which recently made a survey of Omaha stated that 40 per cent. of the so-called electric fires originated from defective cords.

Don't permit "the handy man" nor the incompetent workman to do your wiring.

Don't forget that there are 365 days in every year in which to see that your electric wiring is in first-class shape. Fire prevention week is past, but there are fifty-one other weeks yearly when the same precautions can safely be taken.

Don't forget at any time that good, competent workmanship and first-class materials used in the installation of electric wiring make the best and safest job of work.

Don't overlook the fact that the electrical department is anxious to furnish service and will be glad to offer suggestions for your wiring job. Some of them may prove useful.

* * *

The Induction Motor and Its Application

By J. H. CASTER,

Assistant Engineer, H. E. P. C. of Ontario

THE popularity of electricity for power purposes is due chiefly to the induction motor on account of its ability, reliability and simplicity. Practically any piece of apparatus or group of machines can be driven by a motor more directly and with less expense from an installation standpoint than by any other means. The induction motor is compact, almost noiseless and requires so little attention that it is used wherever electricity is available.

An induction motor can be built to meet every and any conceivable condition and has been standardized for the voltage and frequency commonly available. The choice of a motor for any particular job is governed,—firstly by the work to be done and secondly by the power supply. In Ontario, 25 and 60 cycle power is used and supplied at voltages from 110 to 4000. Small motors are usually operated at voltages from 110 to 550. Motors from 5 to 50 horsepower are supplied with voltages from 220 to 550 and the larger motors with 550, 2,200 or 4,000. Due to the higher standard of installation and inspection, the higher voltage is less to be condemned than formerly and much to be preferred on account of lower installation costs. The standard motor cannot be expected to meet extraordinary conditions but a special motor can be built to do so. In the past practically no attempt was made to secure suitable motors. If the starting duty were heavy, a larger motor than was necessary to operate the load after it was started was was bought in order to take care of the heavy starting condition. This resulted in high operating costs as well as a more expensive installation.

Frequently the purchaser has relied upon the salesman and on his limited knowledge of things electrical to obtain a motor which would do his work. This has resulted in some cases in his obtaining the cheapest motor on the market, while in other cases where the consumer wanted the "best" in getting a motor much too large for the job. In either case he usually got what he termed a good motor. By this is meant that it did the work, and, until he was penalized for poor power factor, the customer was as a rule quite satisfied.

In Hydro municipalities it is not enough for the Superintendent to simply maintain a supply of current. His job is to give service at the minimum cost to all customers. This means that he is to keep the price of power as low as possible and further to see that it is not necessary to penalize his largest customers, namely, the power users. Where the municipality is penalized on account of low power factor, the result is a higher resale rate. The proper motor installation will practically eliminate the penalty both to the customer and to the municipality, and, in order to obtain the results aimed at, it is essential to keep in mind the characteristics of the induction motor and to select motors for each installation, which will best meet the demand. A study of the curves attached and the accompanying table, from which the curves are made, will give considerable information. They show that the power factor of high speed motors is considerably greater than that of low speed motors. This is due chiefly to the fact that there is less iron in the small high speed motor and, consequently, less exciting current. Another noticeable feature is that the power factor increases from no load to load and one-half and does not fall of until approximately double full load is reached. The efficiency also is higher for high speed motors than for low speed motors, and, although less noticeable, is due to the endeavor of the designer to keep the efficiency up, which is done at the expense of the power factor. The true efficiency is the product of power factor and efficiency and is known as the apparent efficiency. All motors should be chosen on the basis of apparent efficiency, other things being equal.

Contrary to the general impression, the starting torque of the high speed motor is usually better than that of the slow speed motor and there are few places where the latter should be recommended, the outstanding exceptions being as follows:

(a) Where direct connection is desirable.

(b) Where space is limited and the proper size pulleys cannot be used.

(c) Where heavy overloads of short duration occur. In this case the large motor has more heat storage capacity and short overloads do not increase the average temperature rapidly.

Motors are rated on a heating basis, the nominal rating being 40° C. rise at continuous full load or 55° rise

after load and one-quarter for two hours. The 50° motor is maximum rated and will carry only small overloads of short duration. Roughly, it is equivalent to 85% of the 40° motor. Where the load is known, it is advisable to purchase 50° motors due to the better characteristics and lower cost. Referring to the curve, the power factor of the 50° motor at full load would be approximately that shown at 125% full load, which is from 2% to 3% higher. Where heavy starting duty is required, the wound rotor motor is advisable or a special designed squirrel cage motor.

Summing up, we find that the cause of penalty or high operating costs is:

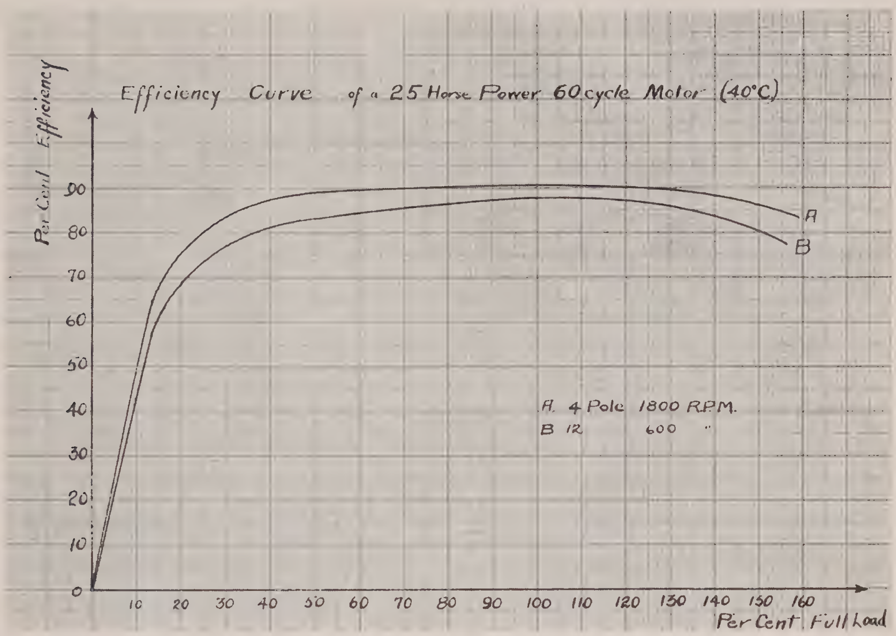
(1) Over motoring. Too large a motor for the job.

(2) Wrong class of motor. Slow speed 40° motor used instead of a high speed 50° motor. Large motor to take care of heavy starting in place of the proper size motor especially designed for heavy starting.

(3) Improper layout. The use of a number of small motors on individual drives where one large motor driving a group of machines would be preferable.

(4) Carelessness or expediency. In accepting any kind of motor easily available without regard to the operating characteristics or the effect on the system generally.

Much can be accomplished in the way of better and cheaper service where the co-operation of the customer, the engineer and the manufacturer can be obtained. Improvements in design and operating characteristics of motors can only be expected where there is a demand for better things. Some manufacturers have already designed motors having considerably higher power factor than has been obtainable in the past, and undoubtedly, better motors will be built if the demand is created. The managers and superintendents should first familiarize themselves with the subject and give assistance to their customers. The engineers of the Commission are available and ready to assist with their experience and should be called upon for advice in all cases. Low power factor, due to motors, is chiefly noticeable in 60 cycle districts and an earnest get-together policy must be followed to overcome the waste of money and equipment. The installation of condensers, such as synchronous motors, is sometimes necesary and adviable, but in a way is adding a trouble to correct an existing one and should be used only when it is impossible to maintain suitable operation by the selection of proper induction motors.


Efficiency Curve of a 25 Horse Power 60 cycle Motor (40°C)
Per Cent Efficiency
A. 4 Pole 1800 R.P.M.
B 12 600 "
A
B
0
10
20
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40
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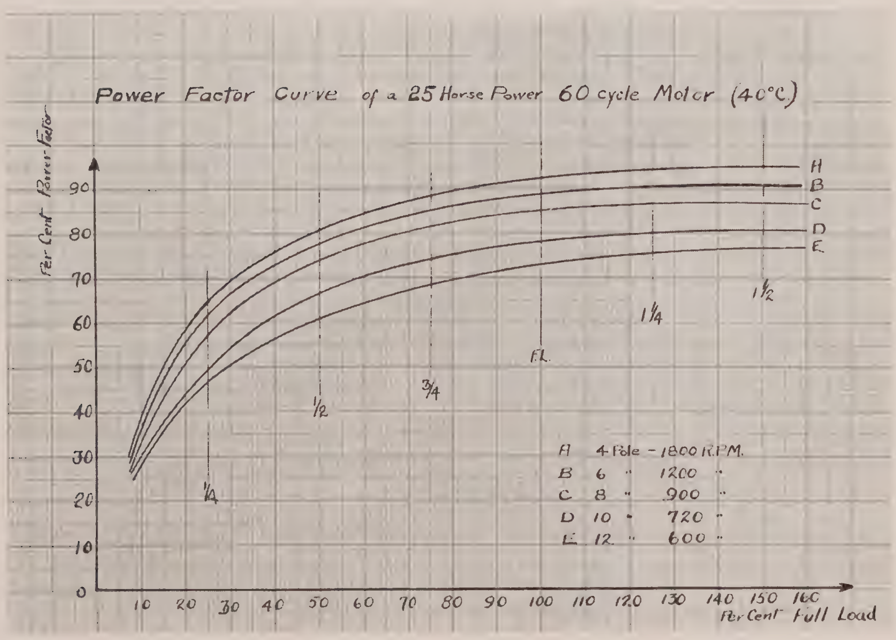
60
70
80
90
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
Per Cent Full Load


Power Factor Curve of a 25 Horse Power 60 cycle Motor (40°C)
Per Cent Power Factor
A
B
C
D
E
1/4
1/2
3/4
F.L.
1 1/4
1 1/2
A 4 Pole - 1800 R.P.M.
B 6 " 1200 "
C 8 " 900 "
D 10 " 720 "
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Per Cent Full Load

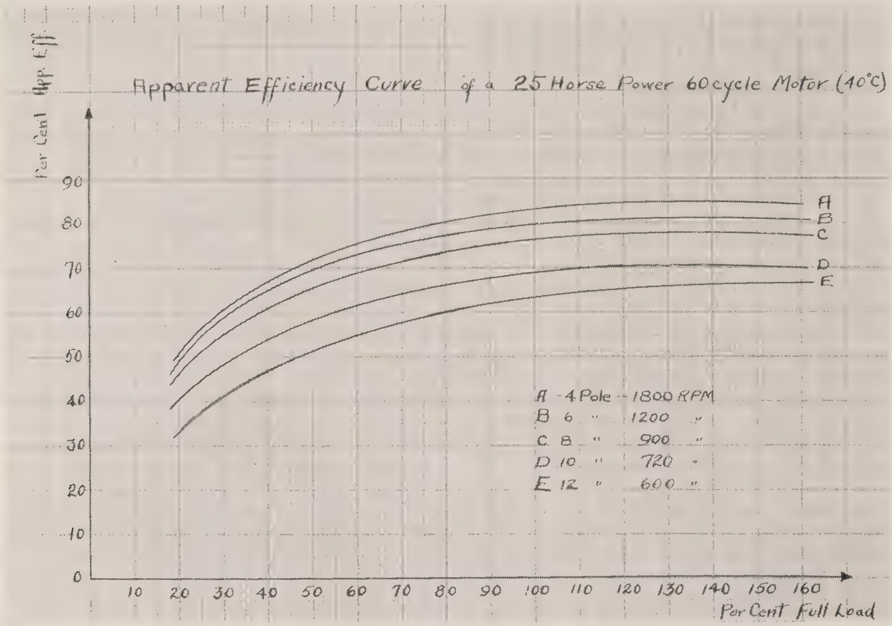

TABLE OF EFFICIENCY, POWER FACTOR AND APPARENT EFFICIENCY (APPROXIMATELY) OF A 4, 6, 8, 10 AND 12 POLE 25 H.P. 60 CYCLE MOTOR.

	Load	½	¾	Full	1¼
1800 R.P.M. Motor—	Efficiency	89	90	90.5	90
	Power Factor	81	88	92	94
	Apparent Efficiency	72.1	79.2	83.3	84.6
1200 R.P.M. Motor—	Efficiency	88.5	89.5	90.0	89
	Power Factor	79	85	89	91
	Apparent Efficiency	70	76.1	79.7	81
900 R.P.M. Motor—	Efficiency	88	89	90	88
	Power Factor	74	81	85	87
	Apparent Efficiency	65.2	72.2	76.5	76.6
720 R.P.M. Motor—	Efficiency	87	88	89	88
	Power Factor	67	74	78	80
	Apparent Efficiency	58.2	65.2	69.5	70.4
600 R.P.M. Motor—	Efficiency	83	86	88	87
	Power Factor	61	69	73	76
	Apparent Efficiency	50.6	59.3	64.2	66.2

Hydro News Items

Central Ontario System

Electric consumers in the recently annexed Cedardale section will get the benefit of Oshawa rates on their next lighting bills.

* * *

The ornamental street lighting in Trenton is now entirely completed. There are 46 cast iron standards and two wall bracket mountings, using 600 c.p. lamps. The completion of this lighting system with the new pavements has resulted in a great improvement in appearance to the business district.

* * *

The Canadian National Railways are using electric drive in their rail re-sawing plant at Belleville.

* * *

The general improvement in industrial conditions has shown itself in a large increase in the Kingston load. Negotiations are under way for a supply of power to the Canadian Locomotive Co., who have recently received a large order from the Canadian National Railways.

* * *

The paper mills at Strathcona and Camden East are operating at full capacity.

* * *

The first section of rural lines in Kingston Township, built under the Rural Hydro-Electric Distribution Act went into operation in December. Plans are being prepared for extensions in this district to serve Westbrook and Collin's Bay. The present system supplies Cataraqui Village and the vicinity.

* * *

The Findlay Company of Norwood, have installed a 35 h.p. motor in their wood working plant.

* * *

Plans are being considered for the construction of a new Municipal Substation at Peterboro.

* * *

Niagara System

Four generators are now in operation at the Queenston plant, and all are loaded to capacity. It is expected that the fifth unit will be put into operation within the next few weeks.

Orders have recently been placed for three additional units, and these will be installed as rapidly as possible. The load on the Niagara System is increasing at a remarkable rate, and the full capacity of the plant will be used up by 1926. It is necessary, therefore, that immediate steps be taken to provide for an additional power supply.

* * *

The Hamilton Hydro-Electric System recently purchased an Office Building near the corner of King and

James Streets. Extensive improvements are now being made to the building, and it is expected that it will be ready for occupation about April 1st. We are advised that the formal opening is to be an event of considerable local importance.

* * *

Owing to the rapidly increasing loads in the various municipalities, it is necessary to make provision at once for the increase of transformer capacity in the following municipalities where the sub-stations are owned by the Commission: Port Credit, Georgetown, New Hamburg, Ridgetown, Tilbury, Caledonia, Norwich, Aylmer, Delaware, Embro, Leamington and Amherstburg.

* * *

A sub-station which has been constructed to take care of power requirements in the Beamsville rural power district has recently been put into operation, and service will be available for a large number of rural consumers in this district within the next few weeks.

* * *

The Commission recently completed the construction of a 26,000 volt line extension to Fletcher, and the erection of an outdoor type sub-station at that point. A 4,000 volt line has been constructed from Fletcher to Merlin, and power service was first supplied to that municipality on December 22nd.

* * *

The Village of Wheatley passed Hydro Enabling and Money By-laws at the recent municipal elections, and arrangements are being made to commence the construction of lines to supply that municipality early in the coming spring.

* * *

Power was first supplied to the Village of Belle River on December 5th, and the rural district in the vicinity of Belle River was put into operation on December 20th. This rural district covers a considerable area, and supplies a large number of summer homes along the south shore of Lake St. Clair.

* * *

Estimates in connection with the cost of power have recently been submitted to the Village of Stouffville, and it is expected that the necessary lines will be constructed to Stouffville early in the coming spring. Power will be supplied to this municipality from the Bond Lake Station of the Metropolitan Railway Company recently taken over by the Commission.

* * *

Ottawa System

The Ottawa Hydro-Electric System is now taking a load of over 12,000 h.p., the largest in its history, and has several important loads in prospect, notably the new City Hospital. To take care of its ever increasing demands, the Commission has just completed a new substation which will be fed by new 11,000 volt underground mains, from the Ottawa and Hull Power Company.

* * *

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CONTENTS

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FEBRUARY, 1923

Convention Number

This number of the Bulletin is devoted entirely to reporting the proceedings of the Convention of the Association of Municipal Electrical Utilities, which was held at Toronto on Janauary 25th and 26th. The Association is to be complemented on the success of its meetings held from time to time, but that held recently exceeded any of the previous winter Conventions. Although the Summer Conventions have proved the greater attraction, yet the attendance on this occasion compared very favorably with the most of those held during the Summer.

It was regretted that the President was unable to attend and give his usual hearty welcome. He has, however, forwarded us a copy of the address that he had prepared for the opening which we are publishing herein. It contains an important message, and we commend it to the earnest perusal of all our readers.

The real value of any organization to its members depends upon the cooperation of those members. The Executives that have had the destinies of the Association in their hands, have endeavored to keep it up to a high standard. They wished they could have done better, and at the same time felt that the Association was reaching all classes of its membership. The new Executive has been given a standard to work to and will try to do even more. Let the membership as a whole be ready to cooperate and assist in every way possible. If this is done its officers will then feel that the Association is really doing the work for which it is intended.

The President's Address

By M. J. McHENRY, Walkerville

IT affords me the keenest pleasure to open this Annual Convention of the Association of Municipal Electrical Utilities, and to welcome the delegates and their friends, who are present in such large numbers. It has always been a very gratifying feature of our Convention, that we have such a large representation of the municipalities of the Province of Ontario, who are handling their own electrical utilities. In fact if it were not for the splendid attendance and interest taken in the Convention sessions, I fear, that the Association would have long since ceased to be as active or as useful as it is at the present time.

In welcoming you to this Convention I extend the wish of the Officers and Executive of the Association, that you may spend a very pleasant and profitable time during these few short sessions. Your various Convention Committees have endeavoured to present papers, which will be of valuable assistance to every utility manager, and which will bring forth the best possible discussion. We, therefore, trust, that you will be able to say at the end of the Convention, that it has been a success, and of interest and value to you.

During the year, which has just past, the Association has endeavoured to carry on such work as will be beneficial to its various members and to the industry at large. Your various standing committees have endeavoured to carry on features of the Association work, which have been started in previous years, and at the same time an endeavour has been made to introduce various new items of interest and of value to the industry. It is not my intention to go into these various matters since you will have the opportunity of hearing in detail, the reports of the various committees. Suffice it to say, that there have been attempts made by your merchandising committee, your rate committee, and your accident prevention committee, to gather data and evolve methods of handling these various sections of the work to the advantage of all utilities. Your Executive has endeavoured to co-operate with the other Electrical Associations in Canada, and particularly with the Canadian Electrical Association, in such matters as have direct bearing on the electrical industry of Canada; as for example the endeavour, in conjunction with the Canadian Electrical Association, to have the retest period of meters increased from five to ten years. It is true, that this has not yet been accomplished, but we still have high hopes of being able to interest and convince the Government as to its advisability. If the members of this Association do not feel that much has been accomplished, I would point out, that

it has not been due to the lack of effort on the part of the Executive of the Association, but any failure to produce maximum results has been largely due to the membership of the Association at large.

This is the last opportunity I will have to act as your presiding officer at a Convention of the Association, and I trust, that you will pardon my seizing this opportunity to present to this Association a few things, which I consider to be vital, if it is to continue to be successful. In the first place let me point out, that a member of any Association will obtain from that Association helpful results in due proportion to the amount of interest and work, which that member puts into the Association. Unfortunately there is a large proportion of our membership, which does not take an active interest in the affairs of the Association, consequently this portion of our membership is not obtaining the results, that it should obtain, and it is therefore hindering the other and more active section of the Association from reaching the maximum degree of helpful co-operation. In general, the problems of each individual utility are the problems of the combined utilities, and the maximum efficiency in dealing with these problems can only be obtained through the concerted effort of all utilities interested. Let me therefore impress on the membership of this Association the vital importance of concerted effort and action.

It is not sufficient, that the affairs of the Association should be handled by its Executive without comment, without advice from the membership at large. Your Executive will always endeavour to take such action, that it believes will meet with the approval of the majority of the Association members and such action as will also be to the best interests of the utility members.

At various times there have been comment of some of the members of the Utility Association, that the affairs of the Association are handled by a certain group, solely for the purpose of that group. Let me state most emphatically that this is not and never has been the policy, either of the Association or of its Executive, and if any utility members of the Association feel that they are not deriving the best results from the Association, I would say, that I firmly believe, that such utility members are not doing their part to co-operate and to assist in carrying on the logical work of the associated utilities. At certain times, the Executive of this Association has found it advisable to consult the various members of the Association through the medium of questionaires. The lack of interest shown by a large representation of the members to these questionaires has been deplorable. In one instance I believe some 130 questionnaires were sent out, and replies were received from approximately 30 of the members. I mention this point to demonstrate to any utility members the fact, that if they feel that they are not being taken care of the fault is largely their own in, that they are not doing their part in co-operation.

In closing I wish to make as strong a plea as possible for the renewed in-

terest of every Association member in the activities of this Association. Every member has the same right to criticize, to discuss and to suggest the solution of the problems of this Association and its member utilities. Let each Manager and Superintendent feel, that he is one of the vital links in our chain of co-operation and that it is up to him to assume his share of the strain and responsibility of our work. I can assure you, that your Officers and your Executive will always welcome constructive criticism, advice, or suggestions, and most of all the heartiest co-operation of every member of the Association. Unless the individual members are prepared to stand together and each to assume his share of the responsibility and the work, it is useless for this Association to attempt to carry on any program, which will be beneficial to its members or for the improvement of the electrical central station industry in this Province.

Gentlemen, I thank you for this opportunity. I thank you for the honour you have conferred upon me for two consecutive terms, and I wish to also thank the members of the Executive who have this year given such loyal support and done so much work for this Association. To the incoming Executive, I extend my best wishes, and my assurance, that anything, which I may be able to do to assist them will be most cheerfully done. I again express my wishes for a successful Convention and for the renewed enthusiasm of the members of this Association.

Line Construction in Municipalities

By J. G. JACKSON,

Manager, Public Utilities Commission, Chatham

THIS session was, I believe to have been a joint one with the Water Works Engineers but owing to some change in arrangements the present paper was substituted with perhaps less than the usual time available for preparation, and I shall hope that this will be considered as sufficient excuse for the covering of the subject in a rather general and somewhat incomplete way. It is only intended to present a few notes on charactertistic types of construction and design prevailing in many municipalities with some suggestion as to methods which may best meet operating requirements and facilitate the growth of the distribution systems to correspond with the rapidly increasing demands for electric power for all purposes.

Before proceeding further, however, I feel that some recognition should be given to the subject which was originally intended to be discussed at this session, the grounding of

electric systems to water pipes, and I will therefore read you an item, clipped from a recent issue of a daily paper, on the electrical hazards which beset the life of a plumber.

"The danger that plumbers work under while doing their ordinary duties in connection with the repair of water pipes was clearly shown recently by an incident in which George Carson a local plumber was the central figure.

Called out to repair a water pipe which needed attention he was disconnecting the joint with a wrench when he received a heavy electrical shock so severe that a small round hole was blown right through the face of his wrist watch into the works. He was able to free himself and at once proceeded to find out what had caused the trouble. He stated that at the time he received the jolt he had been looking right at a fuse box which bore the words 'Square D switch makes electricity safe for everybody' and on the face of it something appeared to be wrong.

Mr. Carson said that it is a common occurrence for electricians to ground their wires by attaching them to the water pipes in the house and that there would be nothing against this practice if some kind of a notice were attached to them saying that this had been done. However nothing is said and the plumber has no way of telling if the water pipe he is to work on is carrying an electric current or not until he finds out in this manner. Mr. Carson as his usual custom had started to disconnect the water pipe without disconnecting the electric meter and when the wrench came in contact with the pipe the circuit was completed and the shock was the result."

It should perhaps be noted that the plumber, upon investigating, was found to be something of a humorist, and his adventure had resulted from breaking the glass case of the electric meter with the handle of his pipe wrench.

To return to my subject—the most fertile field for discussion is the outside distribution system, more particularly overhead.

It has been found most convenient to bring feeders out of stations in lead covered cables and if these are to supply overhead feeders they are quite commonly brought up to a station structure, either a steel tower or a three or four pole wooden structure upon which the overhead lines can be dead ended. It is quite desirable that cable terminal potheads should be neatly arranged on the structure with readily separable connections and so placed as to permit the tieing together of two feeders in case of trouble on a cable. It is advisable to mount lightning arresters at the junction of overhead lines and cables as a protection against lightning entering the cables. It is a fact, however, that in many such cases no arresters are used and, either because of the excellence of the cables which manufacturers are turning out, or because the lightning has not found the underground cable to be a convenient outlet the writer does not recall any instance out of a great many such installations where any damage has been done in the cable from lightning entering from the overhead line. In the few cases

of actual breakdown which have come to his attention faulty insulation or moisture in the terminal pothead has seemed a more probably cause of the trouble.

It should be noted that where all feeders are brought out in cable the possibility of lightning entering the station and damaging the switch board or wiring is practically eliminated. The 2,300/4,000 v. four wire primary has come into quite general use within the last ten years and has the advantage over the older three wire delta 2,300 v. feeder in greater capacity, simplicity in distribution and regulation of single phase loads, including the cutting down of hot primary wires to only one for single phase. While the resultant line voltage is higher than with the delta connection the strain on switchboard and cable insulation is evidently less as a result of the elimination of the uncertain surge potentials which were common with the ungrounded primary. With the 2300/4000 v. primary contact with trees is a much more serious matter than was the case with the 2,300 v. wire ungrounded system. A small twig the size of a lead pencil falling in a rain storm across two phases of a 4,000 v. feeder will almost certainly burn off a No. 6 or No. 4 wire and sometimes larger sizes. For this reason tree trimming requires to be especially well done but, at best, if the line must be erected below overhanging trees trouble is to be expected from branches falling in rain or sleet storms. In the grounded 4 wire system the ground side is ordinarily for simplicity and to save a conductor tied in with the secondary neutral in the case of 3 wire lighting secondaries. It should always be borne in mind that a faulty ground return in such a system might result in dangerous potentials on the secondary. For this reason it is necessary to provide an efficient ground connection at each transformer and also to tie the ground conductor to nearby grounds in as many different directions as possible. One of the illustrations shows a type of ground which the writer has used for a considerable number of years and which has proved very satisfactory. This ground is rolled from a sheet of No. 20 or No. 22 galvanized pure wrought iron into an 8 inch diameter cylinder 30 inches long. One side is left open to permit contact with the inner surface also. A No. 6 insulated copper wire is rolled into contact with an edge of the cylinder and solder run into the joint which is then painted with asphaltum to prevent chemical action.

This ground cylinder has a useful contact area of at least 5 square feet without including the full inner surface. It is set by boring an 8 inch diameter hole to a depth of 7 feet or eight feet with the same tool as used in setting anchors and dropping the cylinder to the bottom with the ground wire attached. The cylinder is then expanded into contact with the wall of the hole by ramming the centre full of earth. This ground is at least as easily placed as the driven pipe, costs approximately one-half as much and considering the depth at which it is placed has five times the effective area of a six foot length of 1 inch pipe.

The 4 wire grounded primary makes possible a very simple pole top arrangement for single phase. In the simplest case a single pole top bracket carries the live primary canductor and the secondary is carried on a 3 pin bracket or rack at least 3 feet below. In case more primary or series street lightning conductors are to be carried a cross arm is of course necessary and it is well to remember that a 6 pin arm costs very little more than a 4 pin arm and if installed originally may render a change unnecessary at a later date.

A pin spacing of 13 inches with 30 inches for pole pins has become quite general. While this is satisfactory for ordinary pole spacings it has been found on longer spans, notably railway crossings of 150 to 200 feet, that conductors will swing together at this spacing and therefore double spacing in such cases appears desirable.

Anchoring of pole lines is often a problem, particularly when the logical spot for the anchor appears to fall in a well kept flower bed or lawn. However this difficulty can be reduced to a minimum by the use of a good so-called patent anchor. Unfortunately many types of anchors on the market are not very reliable. The writer has, however, thoroughly tried out for a good many years the Everstick variety of anchor, consisting of two or four circular sliding plates. This anchor is installed by boring an 8 inch hole to a depth of six or seven feet. This takes about ten to fifteen minutes. The anchor with the rod inserted is then dropped into the hole and rammed with a tool until the plates have fully expanded horizontally into the surrounding soil. Tests have shown that in ordinary soil a husky gang of linemen pulling with blocks on a 5/16 inch guy affixed to such an anchor cannot cause it to give appreciably.

In the laying out of an overhead lighting and general distribution system primary lines in order to reduce operating hazards should be limited so far as possible to certain through routes centrally located with respect to the districts fed. With the prevalent and rapidly increasing use of electric ranges, water heaters, etc., secondary copper should be installed of adequate size for a load of several times that in immediate prospect as it is usually cheaper to provide in advance for the load of the next four or five years then to make frequent changes, in addition to the inconvenience which results from inadequate capacity for rapidly increasing loads.

Heavy lighting and range loads frequently appear at points somewhat remote from existing primary lines and in order to give proper service a transformer may be necessary. In such a case extension of the primary can be made by means of a lead covered cable suspended from a messenger. A small percentage of tin in the sheath in such cables is desirable in order to prevent crystallization. A fused cutout at the connection to the open wiring is useful in case only one transformer or a small group is being fed in this way. This arrangement will permit of primary taps through trees, if protected from abrasion, and also on low pole lines originally intended for secondaries only, and if the sheath and messenger are grounded all danger is avoided.

In the installation of lighting transformers secondary drop is the important factor influencing the spacing. Having in view the expanding demand however the tendency should be to install maximum sizes of transformers and compensate for wider spacings during the development of a load by the use of heavy secondaries. In cases where considerable numbers of small transformers of 7½ and 5 k.w. sizes or even smaller were once installed difficulty is now experienced in finding places for these small sizes except by doubling them up.

It seems to the writer that sizes smaller than 15 k.v. are hardly profitable except for rural distribution in view of the extreme probability that a very few extra range and heater services would soon overload the smaller sizes with consequent necessity for change and probable burn outs. In fact when the lower cost per kv.a. is considered, also the fact that the low magnetising currents of 2½% to 3½% now obtainable do not seriously penalize excess transformer capacity the economic size for lighting transformers in municipalities would seem to be 25 kv.a. or larger.

Considerable advantage in secondary regulation and also in transformer capacity to the extent of perhaps 10% may be got by the banking of transformers in a given district. If this is done the transformers so grouped should be fed by a single primary bus tapped to the main feeder through a disconnecting switch.

In power distribution it is usually necessary to provide a platform or enclosure for the mounting of transformers, several illustrations are shown herewith. The best arrangement of wiring provides for disconnecting fused switches so located that the entire structure can be cut dead for the purpose of working on the transformers, thus eliminating the possibility of accidental contacts with primary wires at such times. Suitable fused disconnecting switches vary in cost from $12.00 to $18.00 and also vary greatly in quality. The fuse should be so mounted as to open with the cover of the box, and when closing the lineman should be protected by the cover from possible blowing of the fuse. The best varieties at the present available appear to be those mounted in the wooden boxes with expulsion fuse mounted on the door.

The ordinary porcelain cutouts sometimes give trouble on 25 kv.a. power transformers and are practically useless on larger sizes as a real short circuit or heavy overload will shatter the porcelain.

In providing transformers for a three phase power load it is usually best practice if the load is small to provide two instead of three transformers, permitting expansion to be taken care of by adding the third transformer later. In the meantime two transformers operating at 84% capacity will ordinarily have cost less than three smaller transformers of the same total capacity.

As many as six 25 kv-a. (25 cycle) or three 50 kv-a. transformers can be conveniently mounted on an overhead transformer platform. If larger sizes or more than three of the 50 kv-a. size are required at a single point an enclosure at ground level or slightly elevated is ordinarily the best

practice. In such a case a space must ordinarily be found within the premises of the customer. Such an enclosure should be protected by a substantial fence of good height and should be marked with danger signs.

In placing transformers for power loads the writer is of the opinion that it is best to cut down the number of transformer locations so far as possible, using the larger sizes of transformers and extending the secondary lines to pick up smaller loads. This should be done even though the initial expense in secondaries may exceed the cost of additional transformer banks as less operating costs and hazards will be incurred and the extensive secondary system will permit intermediate power loads to be picked up more readily. The 50 kv-a. transformer size (in 25 cycle and perhaps 50% larger in 60 cycle) would appear to the writer to be a good standard size for power banks as it can be readily handled by the ordinary line gang and equipment. Six transformers of this size in a bank will not cause any trouble and will give quite a large capacity for a single consumer or a group of consumers.

The surprising growth of power loads within the last few years has made it almost impossible to provide transformer banks which will continue to supply any given area for more than perhaps a year without adding to the capacity.

The writer is therefore of the opinion that greater use should be made of heavy power secondaries fed either from the main sub-stations or from transformer stations of at least 500 to 1,000 kv-a. capacity. Quite commonly large transformers reducing directly from 26,400 v. or 13,200 to 550 v. with 600 v. oil switches and heavy secondaries will cost even less than the more usual distribution with intervening primary and pole transformers and will certainly give more satisfactory operating characteristics.

It may be well at this point to refer to the fact that aluminum and copper prices are at present such that even with weather proof insulation a feeder of large size and given carrying capacity can be installed approximately 33 1/3% more cheaply in aluminum than in copper and incidentally the weight will be very little more than half and the strength greater. What is perhaps more important, a 550 v. power feeder which could have covered a distance of 2,500 feet with 5% drop at a given cost in copper may be extended to 3,750 feet with the same drop and at the same cost in aluminum.

As an example a recent installation was made for a load of 300 kv-a. at a distance of 2,200 feet from a sub-station and as it happened sufficient power feeder capacity was not available at the location. In this instance a 500,000 cir. mils. double braid copper 550 v. secondary was run from a transformer in the sub-station, the cost being $2,714.00 for 11,550 lbs. of weatherproof copper conductor upon the basis of 23½c per lb. The cost of six 50 kv-a. transformers would have been exactly the same as this with the cost of extra primary capacity absorbed in addition and the peak load losses and the drop would have been the same in either case. Immediately after this installation was

made a further 100 kv-a. of load had to be added. While this would have necessitated additional transformers, had that method been employed, it was possible to add the new load to the secondary line with the result that the drop at full load would merely be increased to about 7% which would not be excessive and which could be remedied later if desired.

If however, aluminum conductors had been employed a cross section of 795,000 cir.mils. equivalent in conductivity to 500,000 cir.mils. copper, would have weighed 6,877 lbs., and at 26.8c. per lb. would have cost $1,843.00. Approximately the same relation would exist in the case of smaller sizes of conductors down to perhaps 250,000 cir. mils. copper (397,500 cir. mils. aluminum) although in still smaller sizes, or where many taps were to be taken off, the advantage of aluminum would not be so apparent.

Discussion

MR.. J. J. HEEG (Guelph): Probably the trouble Mr. Jackson or the plumber had might possibly have been avoided if the secondaries had been grounded thoroughly every place where it was possible to ground. It is a question whether we ground enough. I think the neutral being grounded and the main attached to the service pipe and the service pipe grounded in the house would make a very good combination and a man taking the pipe apart would not experience any danger by breaking the current and getting burned. In the case of arrestors we have found in our city that a choke coil is almost as much good as an arrestor but both are good. These switches Mr. Jackson speaks of is something we will all appreciate. Some kind of transformer switch is needed when you get up to a high capacity. Line men should not be allowed to go on a wet night and try to put a transformer in that has not got them as it would be very dangerous. We have found that cast iron switch boxes have not panned out any too good.

When calculating the size of secondary wires, is it sufficient to make them of a capacity equal to that of the transformer serving them? This is a question on which there is some doubt.

Referring to telephone wires, we have some that come pretty close to our lines. We have tried to co-operate with the Bell Telephone Company because they have naturally worked hard to apply the Safety First idea, by putting up crossarms, when our wires come close to their poles. We were criticized for doing this, and requested by the Telephone people to get off. What is the general experience in cases of this kind?

A DELEGATE: It was thought some years ago that we should ground secondaries at every third pole.

What is the attitude at this time on this point?

MR.. R. E. JONES (H.E.P.C. of Ont.): As well as grounding at each transformer we instruct our linemen to ground at every service.

MR. H. F. SHEARER (Welland): Mr. Jackson showed us a picture of a reinforced pole and it came to my mind as to what the cost of that pole would be. There is no doubt it has greater strength but is the cost justified in the greater satisfaction to the service. Mr. Heeg has brought up the matter of a secondary line capacity. I think the concensus of opinion of all the managers here is that none of us have yet been able to pick up the information that will give up definite data from which to calculate our secondary lines. What has sufficient capacity to-day gives low voltage tomorrow. We cannot get over that so long as the increase in use of current is going on as rapidly as it is to-day.

MR. J. C. BURNS (Beaverton): I would like to ask in towns where they have no waterworks what is considered the most efficient type of grounding.

MR. HEEG: I would like to add a little more, and ask the Construction Department of the Hydro Electric Power Commission who are building the aerial lines just what methods are used to ground the lines, secondaries and the services.

MR. BURNS: My reason for asking the question is this; the Telephone Company depend entirely on our grounds. We thought it best to go overhead and make a ground in the sub-station building.

MR. H. O. FISK (Peterboro): There is no doubt in my mind that we will have to run the metallic ground back to the sub-station as well as use the water pipes and gas pipes. Having a good ground there will be no difficulty.

MR. E. P. CHAMBERLAIN (H.E.P.C. of Ont.): I might say in answer to one of the questions that it is the practice for the case of the transformer to be grounded in every installation.

MR. BURNS: Isn't it a fact that the Bell Telephone Company will not allow us to put a wire on their poles?

THE PRESIDENT: No, I can show you a set of specifications drawn up by the Bell Telephone Company in connection with joint use of poles.

MR. R. H. STARR (Orillia): In Orillia we have had no trouble at all in co-operating with the Telephone Company and we have no dispute over expense or costs. We unite with them on safety first and with regard to the joint leads and I do not think the Bell Telephone Company will offer any objection at all outside of the high tension. I think that could be overcome by co-operating with them and taking the matter up with their engineers. It is a big factor if we can get away from the double pole line on both sides of the street.

I would like to ask Mr. Jackson the height at which he used the cross-arm, and if that was 4,000 volts using the double spacing. On an ordinary six pin arm using double spacing that would make it 12 pin and I think eight is the largest an ordinary man can reach. With regard to the ground connections, have any tests been made

to show whether any action has taken place between the copper connection and the galvanized iron. Regarding the grounding of secondaries, what has been the experience of those who have tried that out.

MR. V. B. COLEMAN (Port Hope): In Port Hope, as in other towns, we have the Bell Telephone Company to contend with, and our relations with the Bell Telephone Company are all right. If you get the local manager you can get along very amicably together.

We have had a great deal of trouble with large poles crumbling at the base, and have had to reinforce a great many after they have been up four or five years. In some places it has been impossible to put in any anchor and have placed timber at the base of the pole. We cannot as yet tell how long this will last.

MR. S. B. ILER (H.E.P.C. of Ont.): With regard to the Bell Telephone Company I had a conversation with a member of that company when he offered the suggestion of a joint pole. He said it had been discussed at their meetings, and that they were prepared to enter into a joint pole arrangement on a fifty-fifty basis.

I would like to ask Mr. Jackson whether he has made any actual measurements of resistance of sheet metal grounding and what is the relative cost between it and the pipe grounding, that is material cost?

MR. C. McMANN (Sarnia): Within the last month we have made a joint lead with the Bell Telephone Company on a fifty-fifty basis. The telephone company sent their specifications to me. I had to go by them, but they were reasonable. We built a 35-pole line and put our secondaries and transformers at the top of the pole. Our secondaries are from four to five feet above the telephone wires. We find it is very satisfactory and at the present time there is a telephone gang in Sarnia tearing out hazardous corners. They have taken up some of our own poles and given us longer poles in order to clear up these hazardous places. We have built a line on one side of the road using their poles as there was a row of trees we could not get through on the other side. They had their line up but some of the poles were not long enough so they changed those poles to longer ones and all we paid was half the price of the poles. We maintain our own line and they maintain theirs.

Regarding the ground connections we have adopted Mr. Jackson's system, using two cylinders. We go down as deep as we possibly can and fill the hole with charcoal and pour in water. We ground our neutral at every opportunity to the water hydrants, going down two or three feet. We have our transformers grounded as also the services to the houses.

MR. JACKSON: I believe choke coils are a first class idea. In our substation we never had anything but choke coils on 26,000 volts and undoubtedly it would be as good on a transformer. I also believe the arrestors are the better.

An arrestor several miles away has absolutely no control over lightning. Lightning travels at most three or four hundred feet on a pole line and an arrester further away than that is of no service. On high tension lines I

rather prefer choke coils in a sub-station unless there is an extreme probability of lightning, in which case you put in the arrester because the standard practice so far is in favor of it. I have listened to Mr. Creighton of the General Electric Company and he seemed to be quite convinced that lightning does not travel. They have made tests and found that lightning does not travel more than about 100 feet. He does not protect lines with lightning arresters. Protect your equipment if you protect anything by a lightning arrester at the point where it is installed. The choke coil is intended to prevent lightning getting past the arrester and if it does not get past you do not care very much what happens to it. I do not want to be understood as advising against arresters. I have had a case which has been in use a long time and it is still working and not giving any trouble. I do not say that everybody should do that.

There was something said about the size of secondaries. In the first place make the secondaries long enough. The main bus should be large enough to carry the full current. Even then you must provide for four or five years in advance.

With regard to the Bell Telephone Company co-operation, they will permit running secondaries on their line and the charge is $25 per contact. Some of the speakers refer to grounding inside buildings. I think that is all right. If you ground on transformer lines it would be a source of trouble. The only other source is where a high voltage line carries a secondary in which case the secondary is tied in. The secondary neutral is tied in on grounds in either of two directions. In one direction, the transformer coils act as a tie post; in the other you have to ground at either end. With regard to grounding inside buildings my experience is you should not bring into a building anything unsafe or liable to be unsafe that must be grounded inside of the building. It is also prudent not to rely on grounding anything whatever inside a building unless the line is perfectly safe from the outside and then the inside ground wouldn't matter so much. If you use grounds at least equivalent to the type I have illustrated it is just as well to tie 50 or 100 together and bring the neutral or common ground wire back to the station and make a very perfect ground there. You will then have a system as good if not better than a water pipe ground because you have control of it. I believe common grounding of secondaries and primaries is a mistake. If you are relying on one ground and one primary wire breaks you would have an over potential in the service which you would not have, had these grounds been distinct. It is all right where grounds can be tied together. Where you are relying on single grounds the risk is too great. With regard to tests of different grounds I made some tests some years ago but do not remember the exact results. They were satisfactory and the system has never given any trouble. The ground resistance was lower than that of pipe by far.

Mr. Shearer asks something about the cost of our concrete pole. The

pole I showed was not exactly reinforced concrete. It is a pole used in Toronto and Hamilton and some other places. The post itself costs very little more than the pole used almost exclusively in Toronto. If you take a wood pole and trim it up and bore a few holes in it it will have cost exactly the same as one of these poles and will be just as strong or stronger but it probably would weaken in less time. Charcoal in the middle of the cylinder in the holes would contain some water and the charcoal might create some carbonic action. It might be as well to omit charcoal. With regard to the concrete poles crumbling it is all a matter of design and workmanship. The ordinary heavy type would crumble more easily than the ones I have illustrated. In this type there is no possibility of crumbling as there is steel armour inside. In the older type in which bars are placed the pole will be constantly crumbling; however, it is all a matter of design and workmanship. As regards the anchoring referred to by Mr. Coleman you have to meet each case as you come to it.

Measurement of Loads on Pole Type Transformers

By C. E. SCHWENGER,

Distribution Engineer, Toronto Hydro-Electric System

TRANSFORMERS as designed and built by the manufacturers are given a full load capacity rating based on the ability of the transformer to carry continuously that rated full load without developing a temperature in any part high enough to injure the insulation.

Pole type transformers are usually designed to carry their rated full load continuously without increasing the temperature of any part more than 50° C. over surrounding air temperature. This air temperature must not exceed 40° C. That is the maximum temperature at which the transformer operates is 90° C. At or below this temperature the insulation can be operated without injury.

In operating pole type transformers it is important that they be so loaded that at no time will the temperature rise above 90° C., since above this temperature the insulation becomes damaged. The transformer may easily burn out if operated at high temperature and if it does not burn out it will receive permanent injury which would certainly shorten the life of the transformer.

The important point, therefore, to be determined in connection with transformers in service is to be sure that this maximum temperature in

the transformer is not over 90° C.

Before considering test methods, let us consider the service in which transformers are operating when installed on the lines.

In the first place, transformers are rarely loaded with a uniform continuous load such as that for which the manufacturers design and guarantee.

The service most nearly approaching continuous loading is that of street lighting. In the winter months this load is carried continuously for a period as long as 14 hours.

The commercial power service is a fairly continuous load usually carried about 8 hours with a small period of light load at noon and a long period of little load at night. However, the load is usually not uniform but may develop peaks.

The domestic heating and lighting load service which includes the large majority of pole type transformers in service is one far from continuous but consists ordinarily of a long period of light load followed by a heavy peak load. A series of short period heavy loads may occur especially where ranges are being carried.

Therefore the measurement of load on transformers gives information as to the heating of the transformer differing very largely from conditions on which the transformer is rated.

It is obvious that where loads are carried for short periods in form of peaks that a load to bring about a heating condition approaching that for which the transformer is designed, namely, 90° C. will be much greater than the continuous uniform load on which the transformer is rated.

Information as to the temperature of transformers in service may be obtained in several ways, the two most common being on the one hand the measuring of the temperature directly, and on the other hand the measuring of the loading current and deducting from it the temperature. For this latter condition we must know the characteristics of the transformers and also the duration of the load.

For each of these methods a number of instruments are available, the most common being as follows:—

Temperature Indications.

Thermometers.
Temperature Semaphores.
Maximum Thermometers.

Load Indications.

Indicating Ammeters.
Curve Drawing Ammeters.
Max. Demand Ammeters.

Let us consider the merits of each type applied to above loadings in service.

Thermometers and thermometric devices such as semaphores are usually installed so that they are in the hottest oil of the transformer, usually the top oil immediately over the transformer coils. When this temperature is used, an allowance of about 10 degrees must be added to arrive at the actual temperature of the coils. Experience shows that such an allowance is justified and that reliable indications are obtained for uniform loadings not greatly in excess of full load.

The ordinary thermometer is very accurate but requires being read at peak, i.e. when transformer oil is hottest.

A maximum thermometer of the ordinary type would get this reading. However, glass thermometers are very fragile and liable to breakage and therefore are not recommended for ordinary use.

The temperature semaphore types of devices are very good. These operate on the principle of the bi-metallic strip thermometer and give a signal by the dropping of a semaphore whenever the maximum allowed oil temperature has been exceeded. This temperature is usually taken as 75° C. or 80° C. being sufficiently under the 90° C. temperature of coils to be safe.

When, however, a signal of this kind has operated we know that an overload has taken place on the transformer. We do not, however, know the extent of the overload and must conduct further tests, but we have the warning and this is extremely valuable.

The maximum thermometer type of signal goes a step further than the various semaphore types and gives the maximum temperature the oil has reached during any period as well as the temperature at any time. This device is the most useful.

All temperature devices, however, are dependent upon the bulbs being in the hot oil. If the oil level should drop below the bulb erroneous readings lower than actual conditions are obtained and a false security is likely to be depended on. When transformers operate in parallel and any transformer has a blown fuse or is not working for any reason, the thermometric device gives no information. It gives a reading indicating that the temperature is not dangerously high and this condition may go on for a long time before being caught.

Coming to load indications we have the usual line testing set consisting of current transformer and ammeter. Very valuable information is obtained by the use of this equipment but readings must be made on peak and the whole success of this method depends on the readings being taken on peak. The curve drawing ammeter overcomes the necessity of reading on peak but to handle the large number of transformers in service, a great many instruments, and these are rather expensive, are required. To get the results obtained by direct readings some 40 instruments would have to be changed every day to cover the ground. The cost of changing instruments daily would be more than the total cost of obtaining the indicating readings.

A maximum demand ammeter, of which the Lincoln is a good type, would easily take the place of the curve drawing ammeter, it is open to the same limitation as the curve drawing and has the advantage of low initial cost.

Coming back to the indicating readings on peak we have certain well defined operating advantages.

First—If no load reading is obtained on a transformer the Inspector immediately investigates and usually finds fuse blown. He refuses the

transformer and again takes readings. Thus fusing is regularly inspected.

Second—If an overload is encountered the Inspector determines where overload is, i.e. what direction from transformer and locates best position for additional transformer.

Third—He checks the load balance on the transformers and begins steps to have better balancing made.

Fourth—He takes voltage readings at time of reading which is on peak and gives thereby routine information on regulator operation.

Fifth—Takes rough check on transformer temperature by hand.

Sixth—One reading crew gets test on some 90 locations each night on peak.

These results are largely not obtained by the other methods and it is desirable to have visual inspection of transformers in this routine way.

Each type has, in the writer's opinion, however, its own field and these might be summarized in the form of a recommendation as follows:—

For transformers operating singly such as on street lighting and on power banks use the maximum temperature signal but be sure that oil level is kept high.

On single transformers in case a transformer is out of commission, the service is interrupted and a service complaint soon gives the warning.

For large transformers, especially on power service, use the Lincoln type of maximum demand ammeter as a permanent installation or semi permanent installation. The temperature signal might also be used to advantage.

For transformers banked on lighting service use indicating ammeter readings on peak, the peak hour to be accurately determined beforehand for each district by means of curve drawing ammeters.

Another point to be considered, especially for transformers on H.L. services, is the fact that where short peaks of heavy current such as on range loads are handled there is with some makes of transformers as much as 70° C. temperature difference between the hot oil and the transformer coil. It is therefore dangerous to depend on temperature devices solely under such conditions. These are conditions encountered in every day service.

Also where considerable unbalancing takes place on a lighting transformer, a heavily loaded coil may be extremely hot and in danger of burn out while oil temperature, on account of the other coil being lightly loaded, would be below the assumed danger point. This also is a limitation of the temperature devices.

NOTES ON OPERATION.

Transformers operating singly on Lighting service are apt to be wasteful of invested capital, no advantage of load diversity is obtained, and if transformers are loaded efficiently, that is if they carry their maximum load as defined above, a failure of one transformer imposes the necessity of making an adjacent fully loaded transformer take the additional load. With transformers banked with four units in the bank, the failure of one transformer allows the other three to assume the additional load.

This load, if transformer has simply blown its fuse is transferred immediately without any service interruption. Better voltage in banked network is also obtained.

Speaking of use of transformers in banks and illustrating the test methods involved, let me describe a test conducted to determine what advantage in installed transformer capacity was to be obtained over transformers operated singly.

The bank tested consisted of 8 transformers operating as 4 units. The bus connecting the 4 units was sectionalized so that each unit could operate singly or by closing the breaks they could operate as a bank. Each unit was equipped with two Lincoln Demand Ammeters and on one a Curve Drawing Ammeter was installed. The demand meters operate on 10 minute basis and their readings are therefore an indication of load heating the transformers. The number of consumers on the banked network was 127 of which 58 had ranges. It was found that on tests taken daily over a period of several weeks that the sum of the maximum loads on each individual transformer unit when banked was the same as the maximum demand on the whole bank, in other words there was no diversity between combined maximum demand and the sum of the individual maximum demands.

However, when the bank was sectionalized, it was found that each transformer unit had its individual peak usually at a different time to its neighbor and these times varied as much as half an hour. In this case the sum of the individual transformer maximum loads was greater than the combined maximum load by about 10%. Thus by banking we obtain a greater capacity by 10% due entirely to the diversity of time between loads on the network.

The writer was fortunate in being able to determine how much the load on transformers was increased due to domestic heaters, and had a set of curve drawing instruments on bank, for a period covering a period including Oct. 12th, which was a rather cold day just before the average householder had lighted his furnace. The load on this night increased 100% over the previous or subsequent maximum and shows to what extent all available heaters were put in service. Oct. 13th was also a cold night but the furnaces had been lighted and load dropped to its value before Oct. 14th.

Cut-Outs for 2200 Volt Service Their Use and Limitations

By W. B. BUCHANAN,

Assistant Laboratory Engineer, H. E. P. C. of Ontario

THE duty demanded of any device which is to afford adequate protection on a 2,200 volt line is quite definite in any given case but in the general problem depends on the load it has to carry during normal operation and the capacity of the system behind it. The point of opening of the circuit should be easy of access and any fuse element, simple, inexpensive and easy to replace. This point in the circuit should be the first and only one to open under conditions of abnormal current and the function of the cut-out is to reduce this current to zero at the same time that the voltage across its terminals rises to line potential.

Hence the requirements of a satisfactory cut-out are:

1. Ample current capacity under normal condition.

2. Provision or schemes to reduce the energy released at this point to a minimum during the interval of clearing the circuit.

3. Mechanical strength to withstand the effects of the energy released.

4. Final clearing of the circuit with an ample margin of safety.

1. In considering possible conductors we may promptly eliminate all liquids as unsatisfactory. The higher cost, increased bulk necessary on account of low conductivities, variation in rating with change in weather conditions all tend to discount the use of liquids in any standard product though in some special cases consideration may be given them.

Metals differ considerably in conductivity and for general use as fuses silver and copper wires would have to be made very small in diameter for low amperages hence considerable variation in their performance would result under various conditions of use and consequent unreliability in rating. Objection might also be raised to their high temperature of fusion in cases of fuses enclosed in fibre cases as like aluminum they would tend to burn and carbonize the interior. The standard alloys used for fuses seem to be the best materials for the purpose as they have high enough resistance to make a fuse quite positive in its action and the temperature range between the solid form and condition of easy flow of the molten particles is quite narrow.

Time Lag on Various Overloads.

The performance of standard fuse wire is listed by dealers and in general when tagged correctly we have found their fusing currents reasonably consistent with that stated. For

satisfactory protection of transformers these values should be referred to. Considerable difference in the operating characteristics may be expected with different sizes on various overloads.

Two main factors determine the time-lag of the fuse, the heat capacity at the point of fusion and the rate of conduction and radiation of the heat away from that point. Some conception of the possibility of variation may be shown by comparing the Underwriters' requirements with what we have obtained on special test in the Laboratories. The Code requires that a cartridge fuse rated at say 600 amperes should be able to carry 660 amperes indefinitely, should open with 750 amperes, but allows a time lag of 15 minutes for it to open on 900 amperes. On a very special test we had a fuse just open 600 amperes and apparently it could be arranged so to carry 550 amperes indefinitely. On application of 750 amperes, however, this fuse opened in less than .03 of a second. This test was made at 7 volts on 25 cycle current and under other conditions results might have been different but not of such a character as to affect the comparison.

2. Schemes to reduce the energy liberated at the point and during the period of opening the circuit.

The sequence of events is a rise in temperature, then fusion and possibly vaporization of the fuse element. With rise in energy liberated increase in temperature and pressure develops in the enclosing chamber. The cheaper types of cut-out provide a chamber of as small cross-section as can conveniently be used and make it long also though no absolutely positive means be provided for extinguishing the arc. This principle is used in porcelain cut-outs and those enclosed in cartridges.

An obvious suggestion is to shunt the main arc by a resistance (inductive or non-inductive) which would tend to hold down the voltage on the main arc to such a value that it is more quickly extinguished, the shunt resistance finally opening the circuit at higher voltage but much less current interruption.

Another scheme would be to so arrange parts that a stream of non-conducting liquid would be discharged across or through the arc formed on fusion of the fuse element.

Naturally the latter two types would be of more expensive construction but could reasonably be expected to perform their functions more effectively than those of cheaper design.

A drop out link is used in cartridge fuses of 250 and 600 volt rating but this is only another method of elongating the arc quickly and it is doubtful if such a scheme could be applied successfully at higher voltages.

In the design of a channel which is to contain the fusible element certain precautions are necessary.

The channel must be so restricted throughout its entire length that it will not cause or permit any part of the exhaust gas to short-circuit the terminals throughout its period of operation. Faults of this nature may be found in porcelain cut-outs which permit an arc of large cross-section and short-length to be formed be-

tween the terminals. In many cases, e.g., where small capacity fuse wire is used or where the fuse opens under normal overload this may not be a serious objection but for heavy capacity, e.g. 100 amperes or where extreme overloading occurs such as a dead short on the transformer secondary the length of time necessary to clear the circuit may injure the transformer from overheating or fusion of its winding.

The inner surface of the fuse chamber should be of such a nature that it will not carbonize under the heat of combustion nor permit the retention of the metallic vapors which sometimes condense on the surface and form a conducting film. We have conducted tests on cut-outs where the fuse element was enclosed in a fibre cartridge. The arc blew out the fuse element and cleared the circuit; with rise of voltage the arc struck again along the carbonized interior, blew itself out again and repeated this operation perhaps a half dozen times before the relay system on the transformer bank had time to clear the circuit. This condition is avoided in the cartridge type by enclosing the fuse in a sheath of asbestos tubing or some such material that it blows out with the gases formed clearing the channel entirely. These sheaths are sometimes difficult to insert, however, and there is a strong temptation to maintenance men who do not fully appreciate their importance to leave them out.

The condensation of metallic vapor on the interior of the channel, e.g. in a porcelain cut-out on account of porosity or rough surface may permit sufficient leakage current to re-establish an arc or to make the system otherwise hazardous by failing to clear the circuit completely.

3. Mechanical strength to stand operation.

The question of mechanical strength is of great importance when the cut-out is placed in restricted locations or where flying portions of broken cut-out would be hazardous. This feature is also closely associated with a similar risk to a maintenance man when replacing a fuse in a cut-out where the circuit is faulty. For small ampere capacity, e.g. up to 5 amp., the explosive force would probably be not great enough to cause serious injury when used in a cut-out having a straight draw, but where the force may be great enough to do mechanical injury the parts of the device should interlock in some such manner as will effectually prevent injury to operator or attendant in addition to clearing the circuit.

The stresses which may be set up in the casing of a cut-out appear to be impossible to calculate with a reasonable degree of accuracy as a general problem. The duty is similar to that imposed on a circuit breaker for high voltage service and in the oil-filled type of cut-out the sequence of events is similar to that of the breaker.

The characteristic method of testing the strength of materials is to break a number of samples and assume that according to the law of probability the remainder of the same run or lot of material will approach reasonably close to the average value thus obtained. This assumes that the process of manufacture is such as to

guarantee such a degree of uniformity. Tests under actual service conditions are rather costly and somewhat hazardous to make, but a rather elaborate series of tests has been made by the Laboratories and the results were found to be quite consistent with the foregoing analysis of the conditions to be met and the equipment necessary to meet the same.

4. Final clearing of the circuit with ample margin of safety requires:

(a) Sufficient clearance between points of opposite polarity with a large safety factor.

(b) Insulating material of high quality, e.g. the leakage current should be negligible. Porcelain may possess drying cracks or be porous to the extent of absorbing considerable moisture. The energy loss through leakage current is likely to evaporate lodged moisture before it has a chance to cause harm but the mechanical weakness of porcelain of this grade is an objection. Other insulating materials, bakelite, fibre, glass or oil must be treated on their own merits.

(c) The surface between terminals must be such as to eliminate the chance of leakage current. It should not be exposed where fumes of conducting salts might be deposited thereon and become wet with weather conditions. As previously stated, it should be of some such nature as glazed porcelain or paint which will not burn off with the temperature of fusion of the fuse-element; otherwise an embedding of the vapors released might cause trouble.

Applications—

It seems evident from the foregoing considerations that no single type of cut-out is likely to meet all conditions of service with equal effectiveness. The cheapest type of cut-out properly fused would doubtless be satisfactory for a 5 kv-a. 2,200 volt transformer, while the same cutout would in all probability be blown to pieces on a 50 kv-a. 2,200 volt transformer where dead short-circuited on a line with ample capacity behind it and low reactance between and possibly the transformer would also be destroyed.

We have a condition possible on our 3-phase, 4-wire distribution service which places an additional duty on the transformer cut-outs. This results from grounding one 4,000 volt line directly or by any means which causes its voltage to approach closely to that of ground potential. The cut-out then has to protect the transformer, not from trouble in its secondary circuit but as a result of trying to feed back into a short circuit on its primary side. The equivalent generator voltage in this case tends to become three times normal value. The overload duty on the cut-out is severe and the heating and mechanical stresses are likely to damage the transformer unless the cut-out be very prompt in its action. It would appear to be good practice to open the neutral lead to ground on such transformer banks as carry balanced load in order to avoid the possibility of such excess duty being imposed when avoidable.

A great deal of inconvenience has been caused to customers on account

of the blowing of fuses in the primary cut-outs when starting up motors having a long starting period. In some cases the time lag of the low tension fuses, when installed for normal capacity has been longer than that of the high tension fuses which should have been able to carry twice full load. Such cases are rather special and the rigid application of any general rule would doubtless be a hardship.

One case has arisen in which a motor was required to start a stone crusher and the final capacity probably more than fifty per cent. of the load of the power bank. The operator was advised to fuse up his low tension service switch just sufficient to start the motor, then in this case special provision would be made to over-fuse the high tension cut-outs. In view of the fact that this was the sole customer fed from that bank, that the normal load was well below the capacity of the transformer and the probability of any overload which might occur being of the nature of a dead short the essential requirements of protection seemed to be fairly well met even the high tension fuse should have a capacity of four times that of the transformer it was intended to protect. As far as we are aware no trouble has been experienced during several months' operation.

The attitude of the engineer as a type is essentially "We can accomplish anything within reason and many things out of reason if someone can be found ready to put up the cash." The question of cut-outs for 2,200 volt service is such a problem and in the present state of development it is not so much a question as to whether satisfactory protection can be obtained as to have it done at the lowest reasonable cost. As a general solution it appears that on distribution lines of small capacity and small loads the cheapest type of cut-out may be used with satisfactory results. With lines of larger capacity and low reactance even with small loads an absolutely reliable cut-out should be used. With lines of larger capacity and loads of one hundred amperes and higher, only the most reliable types should be used and above this we get into the field of the automatic oil circuit-breaker.

Exact figures have not been given in defining these limitations as the fixing of such limits is a more arbitrary matter than the writer is prepared to deal with at the present time.

Discussion

MR. H. F. SHEARER (Welland): I am sure the papers we have listened to this afternoon will be appreciated. The paper by Mr. Schwenger was particularly interesting to me because of a few investigations I have been making on our line work. We were considering transformer testing at the first by using an indicating demand watt meter, measuring the load on the primary side. We found it did not give us the information we were after. We then put Lincoln demand meters into service which gave

very interesting results. Mr. Schwenger mentioned the use of the thermometric type of measurement. It strikes me the thermometric measurement is good only if made somewhere near or in the danger zone. I quite agree the other tests may be advisable in the larger systems but in the smaller systems our experience has been that the Lincoln demand meter is the best. You can not only get very useful information but it also serves to protect your transformers from failure in so far as you are able to protect them because of ascertaining the quantity of the load.

The cut out factor is very interesting. We have different methods to protect workmen and linemen in refusing. One is a stick about four feet long having a clamp device on the end to hold the block. The operator being four or five feet from the block is out of danger in case of trouble.

MR. C. BAKER (Packard Electric Co., St. Catharines): I would like to compliment Mr. Schwenger on the way he has put his paper together. He has collected his data in a very careful manner but does not draw conclusions, leaving that to the reader which makes the paper doubly valuable. He states the temperature usually taken as 75 or 80 degrees, being sufficiently under ninety to be safe. He probably had in mind the conditions under which copper sometimes rises sixty or seventy or eighty degrees above the temperature of the oil. The A.I.E.E. state 105 degrees as the safe temperature limit for the copper, for that reason the Standard Company of Philadelphia have set their warning signal at 79 degrees, and the final signal at 89 degrees. We have set this at 90 degrees believing that to be pretty well under 105 degrees. That is, of course, a matter of opinion and any operator can set it at any temperature he desires.

He states that when the transformers operate in parallel and any transformer has a blown fuse, the temperature indicating device becomes useless. I entirely agree. When we have two or three or four in parallel we notice how the temperature signals are lining up. If one blows a primary fuse its signal will remain stationery and the others will immediately jump up because the extra load will go to them, which gives you the warning something is wrong. If there is a signal on one transformer only the bank is not properly equipped. Then again Mr. Schwenger mentions trouble from considerable unbalancing of load using the Lincoln ammeter to balance it. After balancing your load watch your signals to see you do not get over a safe temperature.

MR. W. R. CATTON (Brantford) In Brantford we have about 1,000 stoves and 5,400 customers. Therefore we have transformer measurements going on. We started rather early in the game and cut in to the transformer on the high tension side. We hung the meter on a pole step left it there two or three days or long enough to get the maximum demand, which usually occurs on a cold day. It gives us the reading in watts and we find it to be a real way of measuring. This gives us real valuable information.

MR. J. G. ARCHIBALD (Woodstock): We try to get a twenty-four hour record with a Graphic ammeter which gives the information required.

THE PRESIDENT: If I might be permitted to add a word, gentlemen, I feel pretty clear on three points. In a three way system, we ought to have transformers in parrallel on the primary side and in a series on the secondary side. It is the only way to prevent overloading on one side. I also think the only proper way to obtain readings is to use the graphic ammeter. I agree with Mr. Schwenger when he says it is an expensive and slow method, but you then know when you have reached the peak load. The ammeter should be on for seven days. We have seven ammeters in use and a gang going around changing them. We figure it costs us $3.25 to test a transformer, but during the past year or so we have had practically no failures, so it is well worth the expense. I also recommend in connection wi[th] the measuring of loads on transformers by graphic meters the use of the temperature signals. I think they are excellent for keeping track of the transformers. The characteristic of the load is something that is important and that is why I would still have the graphic ammeter instead of the demand ammeter. The demand ammeter does not give the characteristic of the load.

MR. R. H. STARR (Orillia): We have been using the graphic ammeter for the last three years but have changed over to the Lincoln meter. We found in a good many cases the ammeter showed a dropping down below the dial reading during the night due to the meter shifting and becoming out of true balance by the action of the wind. We felt we were in sort of a false security and took on the Lincoln.

MR. P. B. YATES (St. Catherines): I have been doing some testing of transformers and the conclusion I have reached is that no system commonly in use is very conclusive and complete protection. To have a graphic demand meter operate properly there should be one on each side of the transformer or if you have two transformers there should be graphic meters on both. I believe the Lincoln demand meter gives you the information you need. We are using in St. Catherines, and I find it gives us good results, a hot wire instrument, a demand meter which we put on a block and put in one side of the transformer. It is very easy to operate and gives information as to the maximum load on the transformer at sometime during the period in which it is in use. If it is anywheres near the danger point we know it; if it is not we know it. It is the quickest and easiest way I know of.

Regarding cut outs I do not know what is in common use nor have I spoken to anyone about it. We use a different size fuse in order to protect the operator who is refusing a transformer. We make it a rule on all our transformers of fifteen kilowatts or over to put in the right hand fuse first and the left hand fuse which is larger afterwards. If there is trouble on the circuit or in the transformer it blows the right hand fuse. The lineman is the length of the cross arm away from the cut out that ex-

plodes and out of danger. The matter of cut outs is very important. I think that both of these subjects, the matter of the cut outs and the matter of demand meters on transformers should be given constant study by committees formed by the association to see if we cannot find some better system or some better method of doing the work than we are using at the present time.

MR. CATTON: We are using the standard oil cut out of the explosive type on all transformers of large capacity. On our pole type transformers we use porcelain cut outs and you will all agree that the porcelain cut out makes good racket in time of trouble.

MR. SCHWENGER: I do not think there is any real question. It is a matter of forming ones ideas. The question of cost is one that might be discussed. The way we are working we get it for twenty cents, a reading including costs of truck. We do it on a wholesale scale; we do it once a month. It will give you some idea of the cost for a year. We make on an average eight readings a year on each transformer. We often go over them from month to month. Speaking of setting the safety at 90 degrees, the tests we have recently made showed that when the oil reached a temperature of ninety degrees the coil of the transformer is almost 200 degrees.

Referring to the subject of cut outs, I was interested in Mr. Buchanan's paper. He does not specify the device. We are interested in the relative values of the different devices. I believe the oil cut out is very reliable.

MR. H. O. FISKE (Peterboro): We are pinning our faith in Peterborough to the oil type cut out for large demands. As to checking up our transformer loads we use the block and it is remarkable the number of readings that can be made in a week. During the holiday time we go over the commercial transformers repeatedly. We never know what is going to come on them in the way of extra loads or heaters. The man that is doing that work somehow develops a sixth sense and he can pretty nearly always tell what is going to happen.

Reports

Auditors Report

Toronto, January 9, 1923.

Mr. M. J. McHenry,
President,
Association of Municipal Electric Utilities of Ontario.

Dear Sir:—

We beg to advise that we have examined the books of the Association of Municipal Electric Utilities for the year 1922 and have found same to be correct. The total receipts during the year from all sources totals $2,627.31, the Disbursements $2,430.46, the Balance in Bank is $985.92.

Statement of Revenue and Expenses for Year 1922.

Revenue

Cash on hand	$ 789.07
Convention Dinner (Jan.)	336.00

Convention Dinner (June)	457.50
Municipal Members Fees	1,268.50
Commercial Members Fees	380.00
Bank Interest	26.62
Convention Exhibit Fees	127.75
Convention Bulletin Sales	30.79
Bank Exchange	.15
	$3,416.38

EXPENSES

Printing and Postage	$ 525.82
Travelling Expenses	477.61
Banquets	916.50
Reporting	141.95
Secretary's Salary	75.00
Entertainers	121.65
Bank Exchange	17.69
Convention Exhibit	138.25
Miscellaneous Expenses	15.99
Cash on hand	985.92
	$3,416.38

Respectfully submitted,
W. G. PIERDON,
Auditor.
H. P. L. HILLMAN,
Auditor.

* * *

Report of Committee on Accident Prevention and Health Promotion

Acting on a recommendation of this committee that the Hydro-Electric Power Commission should arrange, for the benefit of the smaller municipalities, to institute a system of inspection for the purpose of pointing out proper methods of construction from a safety view point, it was agreed that nothing could be done until a proper set of rules was prepared. The Hydro-Electric Power Commission standardization rules for outside construction were considered and it was decided that these were too comprehensive for the average line foreman, and the opinion seemed to be that a set of working rules should be gotten out so that these men would understand them. These rules should include working drawings of standards of construction. A sub-committee was appointed to look into the making up of the rules, and the following letter was sent out to 7 representative utilities.

November 17th, 1922.

"At a Meeting of the Committee on Accident Prevention and Health Promotion held at the office of the Hydro-Electric Power Commission, Toronto, on July 4th, 1922, a sub-committee was appointed to enquire into the rules for the installation of supply lines having special regard to Safety and Accident Prevention.

The proposed rules for outdoor line construction, as drafted by the H.E.P.C. were discussed. I understand that you are familiar with these rules. They are very complete, but are thought to be not concise enough for the use of the line gang in the field. Under separate cover I am forwarding to you a copy of the Standards and Rules for Overhead Construction as supplied to the line foremen of the Toronto Hydro-Electric System. These rules differ from the larger H.E.P.C. drafted rules in some minor respects, they include working drawings, standard conductor sizes, etc. Would you, therefore, kindly examine these rules and advise whether in your opinion a set of similar rules would be suitable for the man in the field,

especially the man in the smaller municipalities, giving at the same time a list of revisions which you may deem necessary. An expression of opinion from you, on whether the rules should still further be condensed, or whether the larger H.E.P.C. rules are preferable, will be appreciated.

Your co-operation in assisting the Committee is especially requested as a report on this matter is to be made to the General Committee on Accident Prevention. We would like your reply as soon as possible as it is proposed to report on this matter at the A.M.E.U. Convention in January."

Yours truly,

(Signed) C. E. SCHWENGER,

Chairman of Sub-Committee.

Replies were received from 5 of those utilities and the consensus of opinion was as given in the following letter:—

January 4th, 1923.

Mr. A. T. Hicks,

Hydro-Electric Power Commission,

Oshawa, Ont.

Dear Sir:—

"Replying to your communication of December 28th I would advise that your sub-committee held a meeting on the 2nd inst., and from the seven inquires sent forward we have received five replies. These replies all indicate that a set of working rules similar to the T.H.E.S. rules would be desirable. Some of those replying suggest that the rules be even more concise than the T.H.E.S. rules. Your sub-committee, are therefore, in a position to make a report to the General Committee at any time. Mr. Wills MacLachlan will not be in the city during the week of the 15th inst., and if the meeting were held at any other time other than during this week, your sub-committee would be able to make a report.

As a matter of information your sub-committee will suggest that the H.E.P.C. rules be used as a guide in making up a set of rules with working diagrams similar to T.H.E.S. rules, a work which could be readily undertaken by H.E.P.C. Distribution Department. However, this latter matter is something to be settled by the General Committee."

Yours truly,

(Signed) C. E. SCHWENGER,

Chairman of Sub-Committee.

Your Committee, therefore, recommends that a set of working rules in hand book form, 4½" x 7" be prepared by the H.E.P.C. Eng. staff to be sold to the utilities at cost (estimated approximately $4.00 each).

Committee on Accident Prevention and Health Promotion.

A. T. HICKS, Chairman.

* * *

Report of Regulations and Standards Committee

Your Committee begs leave to submit the following report for 1922:—

The main Committee was not able to deal with the many important matters that should have received attention, being handicapped by the Hydro Electric Officials having to spend the most of their time getting data and information in connection with the many investigations made by Commissions appointed by the Government. The Sub-Committee, however, has

been able to submit a draft on changes of the rules and regulations covering inside electrical installations. Up to the present time the main Committee has not been able to go into the draft in detail, we will be pleased to support anything that will be an improvement on what we have had in the past.

We also wish to report that there is a movement on foot proposing to make uniform rules and regulations covering electrical installations and equipment for the whole of the Dominion of Canada by the Dominion Government. If this Convention would like further information regarding this matter, and also further information regarding the proposed changes by the Sub-Committee, no doubt Mr. A. G. Hall, the Chairman of the Sub-Committee would gladly comply with your request.

There are several important matters that might be considered and discussed by this Convention, that is, any old or new rules that might have a serious effect on the cost of wiring small houses and increasing the cost of electrical installations generally. We would, therefore, respectfully suggest that if any member has any grievances or matters to bring up that an appointed time be set aside for the taking up of these matters, and also if the Convention so desires have Mr. Hall give us an outline of what has been accomplished by the Sub-Committee and the Canadian Engineering Standards Association.

Since coming to the Convention I find that Mr. Hall has gone to Chicago, I believe in connection with the proposed Government regulations. Everyone will agree that it is time for something to be done to get a uniform set of rules. The provinces all over the Dominion of Canada have different rules and regulations. If the C.E.S.A. accomplishes what it proposes doing it will be a good thing. I believe we may look for something in a year's time.

All of which is respectfully submitted.

Regulations and Standards Committee,
JOHN J. HEEG, Chairman.

* * *

Minutes of Convention

The Convention opened at 2.30 p.m. on Thursday, January 25th, at the Prince George Hotel, Mr. E. V. Buchanan, of London, acting as Chairman. He extended to the Convention the regrets of the President and Vice-President in not being able to attend due to illness, and since the President had not sent a copy of his opening address, general business was proceeded with at once.

A letter from Mr. P. T. Davies, President, Canadian Electrical Association, in reference to collecting statistics of the use of electricity was read. It was regularly moved and seconded: That Mr. Davies' letter be referred to the Executive for consideration. CARRIED.

A letter from Mr. A. A. Dion, Chairman, Overhead Lines Committee, C.E.A., asked for participation in the question of establishing standards for overhead crossings of foreign lines. It was moved, seconded and carried that this letter also be referred to the Executive.

A. T. Hicks, President-elect.

The Secretary then presented the report of the Auditors which showed the total receipts for the past year to have amounted to $2,627.31, and the disbursements, $2,430.46, and that there was a balance in the bank of $985.92.

It was moved by Mr. E. H. Caughell of St. Thomas, seconded by Mr. O. M. Perry of Windsor: That the Auditors' report be adopted.

CARRIED.

In the absence of Mr. A. T. Hicks, Chairman, Mr. W. R. Catton presented a report from the Committee on Accident Prevention and Health Promotion. It was moved by Mr. P. B. Yates of St. Catharines and seconded by Mr. O. M. Perry of Windsor: That the report of the Committee on Accident Prevention and Health Promotion be adopted.

CARRIED.

Mr. J. J. Heeg, Chairman, Regulations and Standards Committee presented a report from that Committee and moved its adoption. On being duly seconded the report was adopted.

Mr. V. S. McIntyre of Kitchener, moved and Mr. J. G. Jackson of Chatham seconded a motion: That the Regulations and Standards Committee take up the question of inspecting radio installations with the object of avoiding interference between them and the lines of the local distribution systems. CARRIED.

It was moved by H. F. Shearer of Welland and seconded by Mr. J. J. Heeg of Guelph: That Messrs. B. Faichney, Chas. T. Barnes and G. G. Argo be added to the list of associates. CARRIED.

Mr. F. Gover then addressed the Association with the object of having it holds its next Convention at Orillia.

It was moved by Mr. R. H. Starr of Orillia and seconded by Mr. J. F. Daly of Seaforth: That the Association hold its next Convention at Orillia. CARRIED.

The scrutineers then presented their report of the vote for the election of officers which showed the following duly elected for the year 1923:

President	A. T. Hicks
Vice-President	J. E. B. Phelps
Secretary	S. R. A. Clement
Treasurer	G. J. Mickler
Directors at Large	M. J. McHenry
	V. S. McIntyre
	P. B. Yates

District Directors—

Niagara District	J. J. Heeg
Central District	W. E. Reesor
Georgian Bay District	J. R. McLinden
Eastern District	J. E. Brown
Northern District	S. A. Saylor

Mr. A. W. Ramsdell, Burroughs Adding Machine Co., Detroit, addressed the Association on "Merchandising." The discussion following Mr. Ramsdell's talk was by Messrs. A. B. Scott, O. M. Perry, J. E. Skidmore, A. W . J. Stewart, D. J. Phelan and Wm. Mackenzie.

A very hearty vote of thanks was extended to Mr. Ramsdell for his excellent address.

At 6 o'clock the delegates met for the Convention Dinner, when Sir Adam Beck as guest of the Association gave a very interesting address, which was very much appreciated and heartily received. Mr. J. G. Ramsden, the new Hydro Commissioner was also present, and on being introduced to the Association by the Chairman of the evening, was given a most gratifying reception.

The Ontario Hydro Electric Club held a dance beginning at 9 o'clock on the same evening, and a large number of the delegates availed themselves of this opportunity for enjoyment for the remainder of the evening.

The second session of the Convention opened at 10 a.m. on Friday, January 26th, with Mr. O. H. Scott, the Past President in the chair.

Mr. J. G. Jackson, Manager, Public Utilities Commission of Chatham read a paper entitled "Line Construction in Municipalities." Following his paper Mr. Jackson showed some slides by way of illustration. Discussion following this paper was by Messrs. V. B. Coleman, H. O. Fisk, J. J. Heeg, J. C. Burns, R. E. Jones, H. F. Shearer, E. P. Chamberlain, R. H. Starr and C. McMann.

The third session opened at 2.30 o'clock Friday afternoon with a discussion on Hydro Shops. Those entering into the discussion were Messrs. E. W. Tobin, D. J. Phelan, E. V. Buchanan, W. H. Childs and G. J. Mickler.

During this discussion the proceedings were interrupted for a few minutes to permit Mr. A. Munro Grier, representing Mr. P. T. Davies, President, Canadian Electrical Association, to present a resuscitation medal of the C.E.A., the first of its kind, to Mr. D. E. Donaldson of the Hydro-Electric Power Commission's maintenance staff.

Mr. C. E. Schwenger, Distribution Engineer, Hydro Electric System, Toronto, read a paper on "Measurement of Load on Pole Type Transformers." This was followed by a paper by Mr. W. B. Buchanan, Assistant Laboratory Engineer, Hydro Electric Power Commission of Ontario on "Cutouts

J. E. B. Phelps, Vice-president-elect.

for 2,200 volt circuits, their uses and limitations."

Discussion following these two papers was by Messrs. H. F. Shearer, C. Baker, P. B. Yates, H. O. Fisk, J. G. Archibald, W. R. Catton and M. B. Hastings.

A very hearty vote of thanks was extended to Messrs. Jackson, Schwenger and Buchanan for the excellent papers contributed by them, and also Mr. Tobin who led the discussion on Hydro Shops.

Mr. H. D. Rothwell spoke of the difficulties experienced in introducing single phase power into rural districts, and asked for the assistance and cooperation of the delegates in this matter.

Mr. P. B. Yates referred to the address of Sir Adam Beck at the dinner on the previous evening, and urged the delegates to use every opportunity of bringing before the public the facts concerning the shortage of power that the Province of Ontario would soon have to contend with.

The Chairman then made a few remarks complementing the Association on the success of the Convention and again expressing regret that the retiring President had been unable to attend, after which the Convention adjourned.

The register shows the attendance at the Convention to have been as follows:—

Class "A" Delegates	68
Class "B" Delegates	23
Associates	33
Commercial Delegates	64
Guests	2
Total	190

There were 204 at the Convention Dinner, making a record for Conventions held at Toronto.

Mr. A. W. Ramsdell's Address on "Merchandising" will appear in the March number.

THE

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CONTENTS

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MARCH, 1923

Appreciations

One princple that has always been foremost in the minds of those who have had the direction of the destinies of the Hydro-Electric Power Commission of Ontario and the Municipal Utilities served from it, is that electrical service should not be considered as a luxury, but rather as something of maximum usefulness within the reach of all. That that end has been accomplished and that people appreciate this fact is without doubt. The following letters extracted from the Toronto Globe show that the efforts in this direction have not been without results, and are an open expression of appreciation of what has been done:

Housewives and Hydro

To the Editor of the Globe: May I, a Toronto housewife, speak a word of appreciation of the service I receive from the Hydro. It seems to be too good to be true that hard work disappears almost magically from the home as modern electric conveniences enter and at a cost that might be considered reasonable were it double what it is. I cook, sweep, wash, iron and sew with electric power, have a well-lighted home and a margin of leisure which could not be obtained without the help from the Hydro. I am not versed in politics one way or another, but in my humble opinion I consider Sir Adam Beck's public service too valuable not to be sought, continuously courted and encouraged.

To my way of thinking a jazz newspaper making a lot of noise and not giving justice and due respect to a great man is unwise in its own interests. It appeals only to non-thinkers and people of lesser mental calibre, who accept whatever they see in print.

I believe I voice the feelings of a host of women who would vote with both hands and both feet (so to speak) that all power be given to the elbow of the Hydro. The Hydro gets us there, so "Honor to whom honor is due."

A. D. L.

Toronto, Ont.

* * *

A Hydro Users Protest

To the Editor of the Globe: Your editorial on Hydro affairs, published in the issue of Friday, hits the nail exactly on the head. The owners of the system are the municipalities concerned. . . . . It seems to me that the achievements of the Hydro ought to be taken, by and large, as a general answer.

If the citizens, who are the ultimate owners of the system, are still paying as much for electricity as they were before they were the owners of the generating and distributing plant, and if this municipally-owned plant is behind with its reserves for interest and sinking fund: in short, if it is in a bad financial condition, then it certainly ought to be investigated, and the man at the head of it supplanted by others more able.

But such is not the case. Our managers have a clean record. They have constructed an epoch-making plant. Our rates have been reduced so much that the cost of electricity is a mere bagatelle, and we cease to think of it. Interest has been met. Sinking Fund is in full supply, and, after all that, there is a surplus on hand.

And in the face of this record, there are knockers who want the system to be "investigated."

Now, that is exactly what the owners of the plant do not want. We have a successful business running there and we want the services of Sir Adam as the head, and of his colleagues applied to what we put them there for, namely, constructive action. For this purpose better men cannot be found. I do not mean to infer that Sir Adam is not able to defend himself in a scrap, for as a scrapper there are only a few in his class, and I forget who they are. But his services are far too valuable to the country to be wasted in vain flights to prove what is apparent to every thinking man.

Let a man be judged by results, not by petty transactions. If our commission has not made errors, they are not human. But their work has been so outstandingly successful, putting Ontario in the limelight as having the most gigantic public service organization of its kind in the world, that we ought to overlook every slip and bid them godspeed in their work.

When Hydro was created we were abundantly satisfied—nay, we were rejoiced—to have our rates cut in half. Now, if no change had ever been made in the rates since then, and we were still paying half of what we did pay to the privately owned companies, what a vast surplus Hydro would have! My own rate is about fifty dollars a year. At former prices they would have been around two hundred and fifty dollars. If the commission

saves to every user one-quarter of the difference shown, then two hundred thousand users are saving ten million dollars a year. If that money lay in the coffers of Hydro it would have enough to pay outright for the Chippawa scheme and have a comfortable nest-egg remaining.

And in spite of this showing, are we to ask these men who are responsible for this gigantic work to fritter away their time answering attacks on the enterprise that has accomplished such wonders? My own feeling is that we should rather give them the freest hand possible. Sir Adam's name stands for rectitude and public service, and there is no breath of suspicion on him. Should we not, then, admit that he is a human being, and, therefore, prone to err, but that his record shows unparalleled achievement and that the only sensible thing for us to do is to give him a free range, and expect even greater things.

W. E. SAUNDERS.

London, Ont.

Merchandising

Address by A. W. RAMSDELL,

Burroughs Adding Machine Co., Detroit.

MERCHANDISING is a great subject. I would liked to have lived six thousand years ago and to have seen this question develop from that time. At that time there were two words used to designate amount, *one* and *many*. The human mind could not see beyond the one and more than one was many. We find that in ancient Egyptian they could count to two, beyond two was much or many. It developed down through the ages until we got to count to five and then to twenty. The Ethiopians found that out; they counted on their fingers and then on their toes, and when they got beyond that, they made a mark which was a score and represented twenty. Then people got so they could count to twenty-nine.. They did it like this, one, two, three, four or five and then counted at the thumb, and then they counted in fours and fives and got up to twenty-nine. It was only within comparatively recent years that we have reached the point where we could go on and on; it has only been in very recent times the discovery of the decimal system was made. To-day if you will stop and think you will understand how very few of us can visualize twenty-five; you can visualize five but you cannot visualize twenty-five. We have to go a very long way yet. The day of merchandising, the day of selling things at a profit to everybody concerned, the manufacturer, distributor and consumer is the latest thing in the world, and is one of the

things very little is known about. No real laws have been clearly laid down because no two people talk the same language, the consumer talks one language, the producer talks another and the middle man talks a third.

What happens in business? A man invests money in merchandise to sell, to get more money, to buy more merchandise, to sell, to get more money to buy more merchandise, to sell. It is an endless cycle.

You will find that the average business man watches with utmost care the cash of his business. He uses expensive equipment of all kinds and balances to the cent every day and would not think of anything else. If you went to the business man and ask him to count his cash once a year he would holler for the police. The average business man checks the money owing to his business at least once a month with more or less care and does not seem to think that it costs him too much money to do it. He knows if he left his customers to tell him how much they owed and when they were going to pay, he would not last very long. It is good business to watch both cash and consumer's accounts. Why isn't it equally good business to watch the merchandise as well? There is only one reason and that is tradition! There is no tradition which says we should watch our merchandise because it was only yesterday that business was done by barter, money is new. We have marks to-day in modern merchandising talk of the yesterday that really have not yet gone.

Modern accounting systems for retailers have only just developed. There are many businesses that do not do anything more than just check up once a year. The day of watching merchandise, and knowing what you are doing with it, is absolutely new. Why will a merchant take chances and invest perfectly safe money in dangerous merchandise? The moment we invest money in merchandise there is a danger; but there is a potential profit. The time it takes to open the envelope with the invoice in takes part of your profit. Every moment of the day that the merchandise lies in your warehouse or on your shelves, it costs money, and that must all come out of the profit. Insurance also is a definite part of the expense, and that expense must be charged to the operation in the sale of the merchandise, and when it lies on the shelf it is losing profit. If you can sell right away and collect the money you have made more money on every dollar you have invested. Not much money is lost in cerdit concerns; most people are honest. Few people try to put through false deals. Here is where money is lost; in slow moving merchandise on your shelves. Here is where you have to exert pressure to make more money. Somebody has asked the question, how many of you men dealing with electrical specialties in this organization last year made money. I doubt if there is very much humour in that question if you get down to figures. Mighty few of you made money last year.

I have just got figures in three other lines and in two weeks I made a computation in one of the largest cities on

the continent. I went to many stores, very large and well managed stores. The biggest place I called said we had had the best year in our history, the largest in turnover and the largest in net profit. When I asked for some information they showed me their figures and proved beyond a doubt they had made more money than they ever did before and had done a larger volume of business. Many of these business houses did not make anything and many have lost and given up. Going up and down the streets of a town where three years ago you could not rent a place you could get places on either side of the street, in every block. Business was phenomenally good; bank clearings were wonderful and business was never better. The empty stores were former homes of merchants who were not merchandising. It was the slow turnover and dead stock that was lying there that took the profit out of the business and closed their doors. For every dollar you take in from any source there are three factors: cost, expense and profit. The profit should be from five to eight cents if your business is well managed; if it is not there won't be anything. You can not look for more than eight cents on the dollar. I do not think you can organize your business to-day to get more than from five to eight cents. You can not bring expense down beyond a certain point either; you can not run profit up in view of the fact that you have to take great losses on your merchandise. The difficulty is, instead of keeping records and knowing what we are selling and how the merchandise is sold and the amounts we can handle, some times we just say well things are going fine and I will take a carload and that is what you do. That is not true of your business only; it is true with merchants all over the country. That is the thing that killed the goose that laid the golden egg. There is just as much in the country as in 1918 when we could not get merchandise enough to supply the needs. Now the people do not want it. Somebody asked me when we were going to have good times again --well I think in forty years. I do not think you can drive the world to another world war inside of that time. You will never have times like those we have been through until we have another world war. If you look back at the figures of basic commodities, you will find that every war has brought the same conditions as we had at the close of the war and the period shortly following. You will find the period in between is one of constantly falling prices. The last great war we had on this continent was the civil war. After the close of the war there was no timber, you could not buy lumber. The people were wearing shoes made of oilcloth; you could not buy leather and you could not buy wool; sheep did not have wool apparently in those days; everything had gone to the eternal bow wows and prices were sky high. However, later on, as we have now, there started a period of constantly declining prices and basic commodities fell from that point all through the North American continent until trouble started on the other side in 1914.

I am going to try and show you quickly just where your profit comes from in the sale of a dozen articles. Let us suppose that you are going to sell a dozen pieces of merchandise for $60; let us say they cost you $40; there is a margin of $20. Suppose your cost of doing business is 25%; I am taking 25% on the selling price. Do not try and mark up on the cost price. Let us say 25% is your expense of doing business; that will be $15 for expense and that leaves you $5 for profit. If you start to figure that out you will find that a $5 sale leaves you 42 cts. profit. There is an element of 42 cts. net profit in a $5 sale, but if you will get the correct figures there is no profit at all in a $5 sale. A $5 sale has no profit until you take care of your investment which was $40 on your dozen articles. If you have sold only eight of your $5 articles you have not made any money at all, you just have your investment back. You have to sell three articles at $5 out of the dozen to make expenses and your profit is in the last package and if you do not sell it you haven't made any profit. Those are simple figures and seem very childish but it is the whole basis of successful merchandising. If you have to sell the last article at half price because it is shop-worn you have only made 4%; your banker can do better than that for you and you better go to work for someone else rather than carry on busines in that way. To have six packages lying on your shelves would kill the profit on seventy-two profitable sales and you are still behind the game. Yet it is still difficult to get the merchant to watch his merchandise.

Gentlemen you can make more money in any one year carefully watching merchandise than you can make in five years with an annual inventory and just plunging out wildly. I sometimes wish I could tell you things I see behind the scenes. Mr. Carnegie knew where his interests stood every two weeks; every two weeks he had a profit and loss statement of his varied interests. I do not admire William Randolph Hearst—the principles of the man—but I do admire his business ability and he knows where he stands every night. A report is sent to him from his various interests that is calculated over night and do you wonder that he will go in and pick up a dead paper and have the thing humming in no time at all; competing with all his competitors simply because he has a good system for watching his investment in his business as well as every dollar in the cash register and his bank account. An immense merger occurred some two years ago; there was considerable commotion in the city, people were wondering whose heads were going to fall. The gentleman who was the main mover said you have nothing to worry about. He said I am only concerned in the Accounting Department as we must know where we stand every day. The company which I represent went into his concern with their system and knowing the things inside I am not surprised to see the commodities they handled coming to the forefront. They know they can cut prices and increase profits at the same time. They haven't any competition because competition doesn't know how to compete and

they are setting new standards.

Any of you gentlemen in business and trying to make money should know how much business you have to do to make money. Many business men are working to-day and do not know how much business they have to do in any given day to make money. What would you think of the motorist that started, I was going to say across the desert. Everybody knows if you go across Mojave desert you must know how much oil you have and how much water you have and how much your machine is going to use. If you do not know, you are not going to get there. You can drive around the streets of the city where there is a gasoline station in every block but going out there you must know how many miles you get out of a gallon of gasoline and how many out of a quart of water. Business is exactly the same. You have certain factors that are important to you—you must know your expense. You know your total expenses every month. Divide that by the number of working days every month and find out what your expense is every day. You ought to know your average mark-up—I can tell you pretty near what it is for electrical lines. You will find your average mark-up is around 30%, from 30 to 35%. If you are working under less than 35% you can not make money; it is not possible. You have to have a mark-up of 35% on the amount of business you are doing to make a profit. If you are trying to do it with less than that, you are trying to do something that is impossible. If you know the mark-up and know the expense then you can easily determine how much business you have to do in order to make a profit each day.

I am going to try and show you first the effect of turnover on net profit and second the effect of sales volume on net profit. A manufacturer was making an article for 31 cts. The article sold for 40 cts. and the cost price and the selling price were fixed. The average investment was about 50. If the merchant got two turnovers the merchant's total investment of $50 would buy $100 worth of merchandise which would bring in $100 and 80 cts., his mark-up, so that his gross profit would be $20.80. His cost for doing business was 15 per cent. and his net profit for the year was $9.48, 18% of his investment. Now, gentlemen, as business men, you must figure the profit from the selling price, but if you want to figure how much money you have made you must figure it on your investment. Otherwise you are going to be carried far afield and the load up salesman is going to catch you. Suppose the merchant can eliminate unnecessary lines, and get six turnovers in a year with the same $50 investment he brings in $386.40, with a net profit of $28.44. If he can further standardize those lines and sell what he has standardized, and he can get 12 turnovers a year on his little $50 investment, and $56.80 net profit or 113% on his investment. That is just to show what happens if you keep an eye on your merchandise.

I want to show what happens to business when you can determine your sales volume. Let us suppose for the sake of argument a concern is doing

$100,000 worth of business a year; and the average mark-up is 33⅓%. Suppose the annual sales are $100,000 and the cost of doing busines is 25%. If that is the cost on $100,000 worth of business it costs about $25,000 and in order to maintain a net earning of 8⅓% of 8 cents on the dollar, you must do every day $333 worth of business. Your expenses will be $84.00 on the average and your net profit will be $27.77. With an average business of $100,000 there is an expense of 25% on a 33⅓ mark-up. If the business falls off 20% there will not be a saving of 20% in expenses. You can not cut down your staff. The landlord will not reduce the rent 20%. Your staff won't work for less money and you can't get along without them. I think the item of expense is pretty well fixed in every business. If your sales drop 20% it brings your daily sales volume to $266.67 a day and your expense will still be $84.00 a day. Your net profit has dropped from $27.75 to $5.75. That is the difficulty with the average business. If you can buy things which sell and sell the things you buy, keep your expenses down and increase your sales, possibly you can do $400 worth of business a day with the same stock of merchandise at practically the same expense, not more than $2 or $3 more a day at the outside. And you will have increased your profits from $27 to $50. That is doing business and really making money. If the business men of to-morrow are going to succeed in making a profit in this period of declining prices which I think is going to persist for the next thirty or forty years you must know what it costs you to do business, how much money you have invested in merchandise. You must do that before you can make any profit and you must also know the volume of business you have to do in order to maintain a satisfactory rate of profit.

There is one other thing I would like to mention. One of the curses of the prosperous days during the latter part of the war and immediately following was the fact that the business man began to buy discounts, lots of them. There is no money in buying discounts.

Discussion.

MR.. A. B. SCOTT (Galt): Mr. President and Gentlemen: I do not think that I can throw any light on this subject. We have been in the retail business on a large scale during the last twelve months and our basis of profit has figured about 25% on the larger articles and a little more than 35% on the smaller articles and we found we closed the year with a small deficit.

MR. O. M. PERRY (Windsor): I think this merchandising proposition is something we all have to give more

attention to. It has been said merchandising sales will in times equal sales of electricity; that seems a long ways to go but it is a possibility. With us we are running about one-third, and I hope in time we will overtake it. Mr. Ramsdell has brought out two points, one is the question of turnover. We have learned that lesson and learned it well. Two years ago we ended up with a merchandise stock of $83,000. That was due to the hectic buying we all took part in in the early part of 1920. Prices had a fall and we were left with merchandise in stock. We found that was time to clean house and reduce stock and that we were losing money. After two years we have succeeded in bringing the stock down 50%. Two years ago we had a turn over two or two and a half times in a year, now we have it to five times. I think we have all fallen for the salesmen who have told us if we will buy a six months supply they will give us extra discount. We have all fallen for that and if we will stop and figure out what it is going to cost in dollars and cents we will be very careful not to buy too far ahead.

The next thing is marking up and in some respects we have not got to that method. It is not quite so easy to do. Mr. Ramsdell told us that the average mar-up is 35% for the average dealer. I mean dealers in other goods. You take a haberdasher, a person selling drygoods; he has a figure marked up of what it is worth. He is selling something which is more of a necessity than what we have. We would like to sell washing machines instead. Getting down to hard pan, washing machines are a luxury. We have to get prospects and sell them and after selling we have to service them. He has none of these costs and he gets a greater mark-up. Last year our gross profit was 25% on our sales and our cost of doing business was 23%, and remember we had the advantage of a Hydro shop and being able to take 2% and I am afraid perhaps we let the Hydro fall a little behind. The margin we had the year before I will not mention—it is a very sad thing to speak about. We may be inclined to blame the manufacturer. He is the man that sets the list price. He usually tells us what discount to take and perhaps he is a little to blame. How many of the electrical dealers will not take the margin the manufacturer offers but he is doing business with such little overhead he can afford to keep it down and get prices. I think the biggest thing is to clean house and find what it costs to do business and put the price of these things up where they belong; where we can do business and make some money. You might think that if the prices were increased we might not be able to sell. With these specialties it is not the price we ask for them but it is the salesmanship. If we get the price up we will be able to hire a good salesman and pay him good money and we could sell more articles than we ever did before.

MR. J. E. SKIDMORE (Cobourg): This discussion is very interesting to me for we have a very nice shop in a town of 5,000 and have been able to do considerable business, perhaps as much as any other town of our size. With washing machines and sweepers

we have had more or less success but we only had success because we have spent a lot of money on the servicing of these things. We find the dealer who does not service is in the end bound to lose money and makes very bad friends with people to whom you are selling electricity and water and gas. Perhaps one of the hardest things we have to meet is servicing. One must add service into the price if he expects to make money and honest dealing is a thing that will bring business in the long run.

MR. A. W. J. STEWART (Toronto): I think one of the most important facts brought out by Mr. Ramsdall to-day is the question of turn over. We keep a man spending a good deal of time revising continually our maximum and minimum stock to put the stock of everything else as low as possible without getting where we can not make prompt deliveries. We find there are a number of lines where we can get five or six, or sometimes seven turn overs but at the same time in order to make a fair profit it is important to get all the stock turned over as quickly as possible. I do not think there is anything better that we can do, than what has been pointed out by the speaker, which is to get a quicker turn over.

MR. RAMSDELL: I think Mr. Perry hit the nail on the head. If you have competition you will have no trouble. You must get right down and figure the proposition out; if you haven't the figures you are far away. If you have got figures and you can prove that there is price cutting the first thing is to stop it.

Some of you gentlemen are inclined to buy discounts. I think Mr. Perry will tell you part of their success last year was because they were not buying discounts. They were buying merchandise to sell. I want to point out one thing: you gentlemen from the manufacturers and wholesalers are the best friends and the sale of your goods depends upon the success of the people you sell to. It means in some instances re-organization and I know of cases where it has been done with wonderful success. I do not know of any case where the whole scheme of loading to the walls has been a success. Where it is done by retailers they go down and out. Supposing a man invests $100 and carries it over for a month. His $100 investment takes up $100 worth of merchandise at the end of the month; $37.50 went for expenses and $12.50 profit. For three months you get exactly the same so if you stop and figure the money made on the selling price you are going to get one thing, but if you will stop and figure the money made on the investment you will get another and get a factor of 150% actual earnings for a year. See what happens, somebody comes along and says don't be a piker. You sell the stuff right along buying a three month's supply, I will give you 5% and that for three months is 20%. $300 worth of merchandise costs you $355 and you have against your initial investment from $100 to $285 and have against the period of investment from $50 to $185. At the end of three months if you look at the profit on your investment you will find it is not as large as it was before and you will find it is just as large in dollars

and cents. \$100 turned twelve times a year will bring in on the basis of 33½% mark-up and 25% expenses, \$150 in profit. What is the relation between the investment and the net profit. You will see that there is a profit of 2% in ten days., 2% in ten days means \$24 for a year. On your average investment of \$185 your profit is still some 150%. Your discount earned has dropped to \$22.80 because you haven't so much money to get the discount on. This proposition is better for the manufacturer and for the distributor because he is not carrying so large a liability. This man can not discount but he takes all that is coming and a little more, earning money enough to do business in another way.

If we could only get salesmen and manufacturers, etc. to realize that their interests are identical then there will be no trouble in getting rid of merchandise. Every business man who has to have a commodity marked up should carry as little stock as he can and have records to guide him every evening and in that way the business man can make money. Making money depends on watching every dollar you get across the counter and after you have done that there is 5 to 8 cents left to you. It means co-operation all the way down the line, the manufacturer, wholesaler, distributor and retailer and it is even so among your competitors. Unless your competitors succeed you cannot. We are all in the world together and we have to sink or swim together.

* * *

Keeping Public Contacts from Sparking

By E. L. MILIKEN,
Stone and Webster Management Division
Gas and Electric Company, Woonsocket, R.I.

ON those occasions when friction develops between some member of a public utility organization and some citizen whom it serves it is encouraging to call to mind the rather striking similarity which can be drawn between central-station public relations and the brushes of a generator. Let us look back for a moment at some of the old types of direct-current machines with which, for some inherent reason, we always had commutating trouble, in spite of everything we did. The machines sparked at the brushes, particularly where the nature of the load was fluctuating.

As years went by, however, new types of brushes came into existence which, when applied to these old machines, materially alleviated, if they did not entirely eliminate, sparking. The seemingly impossible was accomplished, owing to advance in the art of producing brushes of higher conductivity or, as we technically termed it, greater amperage per square inch of brush contact. Sparking was perhaps the earliest contact problem in the industry.

The question of public contact today presents a psychological parallel to the technical problem of reducing sparking of commutators in direct-current machines. The company's service may be likened unto the flow of current, and the public to the commutator, while the brush cross-section may be represented by the number of contact employees and the conductivity per square inch finds its parellel in the state of mind of the contact employees. No matter how well the service may be maintained by those directing the company's policy, it cannot flow to the consumer with the least resistance and without undue loss and sparking unless there are sufficient contact employees to render the service, and unless the conductivity through these employees is high; that is, unless they are imbued with the spirit of service.

Continuing the analogy, the direction of rotation must be such as not to cause sparking at the toe of the brush. The consumer's relations with the company and the company's relations with the consumer must be such that the brush will lie flat on the commutator, and all contact employees must function satisfactorily in their respective duties.

The reader may well say that this parallel is more or less a stretch of the imagination. This is admitted. The entire question of improving public relations calls for a very vivid play of the imagination.

Those in any organization responsible for directing its public relations must not only observe but must also

anticipate the effect of the company's policies on the consumer and the effect of the probable errors of certain contact employees in handling the public. Yet to secure the most satisfactory results observation and imagination must go hand in hand. It is possible to go too far in imagining features of a company's service which rub the consumer the wrong way. Closer observation and analysis reveals seemingly unimportant elements in our dealings with the public which may have a marked effect in molding public opinion concerning a company and its service. Such a study will, among other opportunities for service improvement, offer the following very practical suggestions:

Inaccurate Meters and Errors in Billing.

There is no more prolific source of strained relations with consumers than conditions arising out of inaccurate—and particularly fast—meters and out of errors in billing. This is an old story, but there are yet many chapters to be written before "finis" can be placed after any one of them.

The public as a whole has yet to be convinced that the electric meter does not "knock down fares" for the company's benefit. There are still consumers who believe that some iniquitous official raises and lowers bills as best suits his whim and the company' interests. To improve these conditions the management may well decide on a broad policy intended to engender in the public a faith in the meter and in the company's practice in using it as a measure of energy sold.

To do this, first and foremost it is necessary to make rebates voluntarily to all consumers whose meters, either on complaint or periodic test, are found fast. The percentage of such meters is small, and the amount rebated is correspondingly negligible when compared with the favorable effect on the mind of the consumer. Whatever loss in revenue (actually never earned) results from this rebating practice will to no small degree be offset by payments from consumers whose meters have been running slow or failing to register. These payments will become gradually easier to obtain when the public are convinced that the company's practice works both ways impartially.

Let the practice of justly rebating apply to errors in constants as well as in meter accuracy. To the same extent acknowledge errors in reading and billing and rebate or collect as the case may require. These acknowledgments should come willingly. If they are not made promptly and with a good grace, much of their effect will be lost.

Above all, let concerted effort be directed toward eliminating the causes. Instill in the meter readers the importance of accuracy in their work. Let meter installers understand the consequences to the company of errors in constants or in connections. Educate billing clerks to a knowledge of the trouble arising from sending out inaccurate bills. Develop team work between all of those departments and employees whose combined efforts result in the finished bill to the consumer.

Bill Forms.

The evolution of non-confusing,

non-irritating, non-threatening, non-inflammatory, understandable and computable bill forms began long before our problems of public contact were crystallized under the term "public relations." Nevertheless, the ideal bill form has probably yet to be devised, although "soothing syrup" has been administered to most forms. The old type of bill for residential consumers, with its—to the customer—cryptic figures and carefully and legally worded threats to penalize through loss of discount, has gradually been replaced by a simple, open-faced form so designed as to make it possible for the recipient to understand how the amount due is computed.

When we come to bills for power or industrial service under the more or less complicated rate forms in use, some progress has yet to be made. It is to the credit of the utilities issuing bills under these rates that the customers pay them usually without monthly protests. This shows a certain degree of confidence in the integrity of the utilities. But this confidence would be enhanced by an actual and a plain statement on the face of the bill as to how the total amount due is derived.

Making up such a bill will entail somewhat more labor and expense. Yet the customer who pays the utility hundreds or thousands of dollars a month is entitled to a detailed bill. The utility official who received a bill from his grocer for, say, merely "vegetables," "canned goods" and "groceries," would insist that the grocer should furnish details of these three items. If he were told that it entailed too much work so to detail them, he would hardly be content. Similarly, a bill for merely "demand charge" or "service charge," plus so many kilowatt-hours, cannot satisfy a utility customer, even if the rate is printed on the back of the bill. Let's give unto others what we expect from them.

The Order Clerk.

In any electric company the order clerk or the employee who receives orders for service from customers and in turn issues necessary instructions to the operating department regarding cut-ins and cut-outs is a most, if not *the* most, important link in the company's chain of relations with its customers. In some organizations this clerk handles complaints as well and gives general information to all inquirers. When his or her duties are thus amplified, the position becomes doubly or trebly important. Upon the order clerk to no small degree depends the speedy execution of customer's requests and orders.

Not infrequently this clerk is the first point of contact with the customer. It naturally follows that the selection of this employee should be made in a most discriminating manner. A person of pleasing personality, affable, of even temper, having a thorough knowledge of the business and of the company's routine, is not found at every turn, neither are such made in a day. Then, too, he or she must be a student of human nature and must like and sincerely enjoy meeting people. Ordinarily the person who enjoys meeting people other people enjoy meeting.

Moreover, this clerk must be im-

bued with the spirit of service. He or she must be entirely in accord with the management's policies directed toward pleasing the public. All of these other qualities must, also, go hand in hand with the faculty of getting along with all of the other departments of the company. For the order clerk is the pivot around which swing the activities of the sales, meter, service, accounting and collection departments. The ideal order clerk will have the respect and liking of all of these departments. For the proper performance of such a job there should be given to him or her every reasonable and requisite authority. When so vested, this vital employee can do much toward attending to those little niceties of service which give rise to ever-widening ripples of public goodwill. The right kind of an order clerk may be considered the master key which will open many of the doors to public good-will that otherwise would be closed.

Cut-in and Cut-out Orders.

The rapid execution of cut-ins and cut-outs by the operating departments is a prime essential in creating public good will. The public expects expeditious treatment. The longer a family has deferred using electric service the more insistent it is to have connections made promptly.

The average householder who is about to have service connected for the first time is in much the same frame of mind as a child with a new toy. He is eager to see the toy come out of the box at home, which in the case of eletcric or gas service means to see light and heat coming from the fixtures or appliances. Hence it is up to the operating department to see that new customers are enabled to play with their new toy at the earliest possible moment.

Quick connections always make a good impression. Undue delay has the reverse effect, particularly considering the eager anticipation of the new user of service. It therefore behooves any organization giving consideration to improving public relations to cast about and take stock of those things in its existing routine which facilitate or hinder the rapid connection of new customers. The practice of leaving meters in a house from which tenants move, and having service disconnected, does much to render this possible. Service to the incoming tenants can be given more quickly—particularly where entrance boxes are used—than where the meter is taken out and must be put back. The tagging of these locked meters, showing the incoming tenants where to telephone or apply for service, is a further step in the same direction.

There has been in the past altogether too much red tape in the way of a prospective customer securing service. In one instance with which the writer is familiar, it was found that there were twenty-eight items of routine to be undergone before a cut-in order would be issued for a new customer. After careful consideration all of these were dispensed with, and it was made possible for a prospective customer to call the office by telephone and ask to have service connected, whereupon it would be done. No application card is now required and no deposit, unless, as happened in some isolated cases, it is

found necessary to have a deposit after the meter had been put in. In such cases a personal call is made on the customer and the deposit is obtained, or, as rarely been necessary, the service is discontinued. All of this red tape has been cut out on the theory that the customer should not be an applicant for service, but that the company, on the contrary, should seek the business.

The prompt reading of meters and rendering of final bills to customers moving from one location to another in a company's territory, or moving out of the territory, should not be overlooked. This not only has a favorable effect on collections, but prompt service of this kind is appreciated by the customer. We never know when customers leaving our territory may come back, and their last impression of our service is bound to hold over. Our service should be prompt and efficient from beginning to end; that is, from the time they are first connected until the final bill is rendered.

Then, too, there is another aspect of the situation. The industry as a whole should make sure that the impressions brought by customers moving from the territory of one company to that of another are favorable. The good work being done by some one company, resulting in general public good will, will be somewhat negatived if there are constantly coming into its territory customers bringing grievances which they have nursed against the companies serving the territories in which they formerly lived. This is another instance of the value of concerted action in the working of one for the good of all and all for the good of one.

Handling Complaints.

Very little remains to be said on this point, regarding which so much has been said and written. One point sometimes overlooked is the giving of sufficient consideration to the person handling particularly "difficult" customers and "chronic kickers." Don't send a man on a boy's job or a cook to repair a fine clock. Consider each case and pick the man to handle it.

In general, a splendid representative can best be employed by larger companies to do such work. Salesmen, operating men and collectors each have a certain viewpoint which unfits them for handling important or difficult complaints. An unprejudiced mind is essential, and the possessor should as well know the various angles of the business sufficiently to judge each case on its merits. Such a representative should have full authority to settle, without having to keep the matter in the fire for an extended period, which is always irritating to the consumer and militates against a final satisfactory settlement.

In smaller companies the manager is obviously the man to do this work. If he is not capable of doing it well, he probably should not be a manager. The handling of complaints or trouble should not be left to subordinates without a most careful oversight from the manager. The policy of following up trouble calls or complaints by telephone, or by writing to ask the consumer if the matter has been handled to his satisfaction, will serve as a check on the complaint and trouble man, and at the same time it im-

presses upon the consumer the company's desire to serve thoroughly.

The handling of credits, particularly those which are doubtful, is always a ticklish problem. The accounting department is always charged with the responsibility of passing on the credit of prospective customers. This department naturally feels that it should in every possible manner safeguard the company's present as well as future income. Yet to establish a hard and fixed rule in the matter of collection of accounts or the extension of credit to any customer would be very detrimental to public relations. Here again is an opportunity for a careful study of human nature.

Sometimes the householder who has always met his obligations promptly, but through illness in his family becomes hard put for cash, finds it necessary to allow his bills for lighting service to go unpaid. Thereupon arises a great opportunity for the company furnishing these services to demonstrate to him that it is human by recognizing his difficulties and sympathizing with him in the most practical way possible—that is, giving him a reasonable extension of time in which to pay his bills.

Similarly, if some mercantile or manufacturing concern of formerly unquestionable integrity becomes short of cash through a fire or through economic conditions beyond its control, consideration should be shown it through an extension of credit. Of course, all of the considerations entering into each case must be taken into account, but in many instances we shall win the goodwill of those who will in the future be good customers, not only from the standpoint of use but of prompt payment. People appreciate assistance most when they need it the most, and remembrance of such assistance will extend into the future in more or less proportion to the assistance rendered at the time.

In general, the writer believes that most companies, and particularly the smaller ones, follow some such practice as above suggested. The point is brought out, however, in the fear that as companies grow and the more intimate contact with customers which existed under their smaller organization in the bygone days becomes less possible these little humanizing acts may not be performed by those down the line in charge of credits and collections.

Considerable attention has been directed in recent years to improving the general atmosphere prevailing in our offices. In passing, one suggestion may not be amiss.

Frequently when a consumer is paying a bill at a cashier's window, employees of the company may for some reason or another have business with the cashier. All too often the cashier will leave the consumer standing at the window and make change or otherwise transact the particular business which his fellow employee may wish done. This has a most unfortunate effect on the mind of the consumer. Any one who has stood in line at the box office of a theatre or before a ticket window in a railroad station and had some attendant or railway employee taken care of ahead of the whole line of standing patrons will realize the force of this argument.—Electrical World.

Association of Municipal Electrical Utilities

Minutes of Executive Committee Meeting

The meeting was called to order at 2 P.M. on Friday, March 2nd, 1923, at the office of the Hydro-Electric Power Commission of Ontario, by Mr. A. T. Hicks, President. Others present were Messrs. J. E. B. Phelps, J. J. Heeg, W. E. Reesor, G. J. Mickler, S. A. Saylor, M. J. McHenry and S. R. A. Clement, Secretary.

This meeting was for the purpose of making appointments to committees for the year 1923, and taking care of such business as had been referred to the Executive at the recent convention.

It was moved by Mr. J. E. B. Phelps and seconded by Mr. J. J. Heeg: That the Papers Committee consist of Messrs. M. J. McHenry, Chairman; A. B. Cooper, V. S. McIntyre, O. H. Scott and R. T. Jeffery.
CARRIED.

It was moved by Mr. M. J. McHenry and seconded by Mr. S. A. Saylor: That the Convention Committee consist of Messrs. W. E. Reesor, Chairman; J. E. B. Phelps, C. H. Hopper, R. H. Starr, F. Gover, and J. J. Jeffrey.
CARRIED.

It was moved by Mr. W. E. Reesor and seconded by Mr. S. A. Saylor: That the Regulations and Standards Committee remain as last year, being: Messrs. J. J. Heeg, Chairman; E. J. Stapleton, R. H. Starr, J. E. Brown, W. P. Dobson and A. G. Hall.
CARRIED.

It was moved by Mr. M. J. McHenry and seconded by Mr. J. J. Heeg: That the Committee on Accident Prevention and Health Promotion consist of Messrs. S. A. Saylor, Chairman; W. R. Catton, E. M. Ashworth, F. C. Adsett, T. C. James, Wills Maclachlan and S. R. A. Clement.
CARRIED.

It was moved by Mr. M. J. McHenry and seconded by Mr. W. E. Reesor: That the Merchandising Committee consist of Messrs. J. E. B. Phelps, Chairman; O. M. Perry, E. V. Buchanan, E. W. Tobin, W. H. Childs, O. H. Scott, A. B. Scott, A. W. J. Stewart, M. J. McHenry, J. J. Heeg, S. J. Millikin and H. F. Shearer.
CARRIED.

It was moved by Mr. M. J. McHenry and seconded by Mr. J. E. B. Phelps: That the Rates Committee consist of Messrs. P. B. Yates, Chairman; J. R. McLinden, E. I. Sifton, V. S. McIntyre, E. M. Ashworth, H. O. Fisk, J. E. Brown, J. G. Jackson, E. V. Buchanan, J. J. Heeg, M. M. Inglis and C. C. Folger.
CARRIED.

Mr. M. J. McHenry gave notice of a motion that he would move at the next Convention of the Association, to amend the By-laws of the Association so as to include the Merchandising and the Rates Committees as standing committees of the Association.

It was moved by Mr. M. J. Mc Henry and seconded by Mr. J. E. B. Phelps: That Messrs. W. G. Pierdon and R. C. McCollum be appointed auditors for the year 1923.

CARRIED.

It was moved by Mr. J. E. B. Phelps and seconded by Mr. J. J. Heeg: That the next meeting of the Executive Committee be held on Friday, April 13th.

CARRIED.

The chairman of the Papers and Convention Committees were instructed to come to that Executive meeting prepared to report complete plans for the Summer Convention.

Correspondence with Mr. P. T. Davies, President Canadian Electrical Association, in reference to obtaining statistics covering the use and cost of electrical service, which had been referred to the Executive by the last Convention was considered.

It was moved by Mr. M. J. McHenry and seconded by Mr. S. A. Saylor: That the Secretary be instructed to arrange to have a copy of the last report of the Hydro-Electric Power Commission of of Ontario, forwarded to Mr. P. T. Davies, and write him a letter pointing to the portion of that report that gave the information he desired. CARRIED.

Referring to correspondence with Mr. A. A. Dion, Chairman, Overhead Lines Committee, C. E. A., in reference to crossings between telephone and power lines, which had also been referred to the Executive by the last Convention, it was moved by Mr. M. J. McHenry and seconded by Mr. W. E. Reesor: That the correspondence with Mr. A. A. Dion be referred to the Regulations and Standards Committee. CARRIED.

It was moved by Mr. W. E. Reesor and seconded by Mr. J. J. Heeg: That the representatives of this Association on the Canadian Electrical Council for the year 1923, be Messrs. M. J. McHenry, O. H. Scott, P. B. Yates and A. T. Hicks. CARRIED.

It was moved by Mr. W. E. Reesor and seconded by Mr. M. J. McHenry: That the Secretary be paid an honorarium of $100.00. CARRIED.

The meeting then turned to the discussion of ways and means whereby the smaller utilities could receive the greatest possible benefit from the Association. The District Directors were instructed to inaugurate a system of getting in touch with the smaller utilities, with power to call in others in their district to assist them if desired, and allotting to each assistant so appointed a portion of the territory within his district. Each district director would be Chairman of the Committee so formed by him who would bring before the Convention any question brought up by the smaller utility if that utility was unable to be represented by one of its own officials, and carry back to it a report of the action taken by the Convention.

The meeting adjourned at 4 P.M.

Sources of Error in the Use of Electrical Instruments

By PERRY A. BORDEN,

Assistant Laboratory Engineer, H.E.P.C. of Ontario.

This is the first of a series of articles dealing with the use of electrical instruments. No effort has been made to go into any depth of technical detail but only to give a general idea of precautions to be observed so that the highest possible accuracy may be obtained when making electrical measurements. Electrical instruments, as a rule, are both reliable and accurate, but they can not be used with the same freedom as are pliers and screw drivers. And since unexpected or unexplained errors may lead to embarrassing complications, an intelligent knowledge of the sources whence errors may emanate should assist in putting the user of instruments on his guard.

IN electrical as in any other kind of measurement there exist sources of error which must either be eliminated or compensated for if satisfactory results are to be expected. It is not the purpose of this article to discuss in full with mathematical analyses all the possible sources of error but only to treat those which are of sufficient magnitude to affect the ordinary electrical measurements which are likely to be performed in the field or the electrical shop, with particular reference to the standard types of indicating instruments.

In general, there may be said to exist three possible sources of error. These are:

I. Inherent Errors of the Instrument Used.

II. Errors Due to the Method of Measurement.

III. Errors of Observation.

I. Inherent Errors

Inherent errors can not be entirely eliminated, although by a knowledge of their presence their influence may

be reduced. They may be classified as follows:

(a) Temperature errors.
(b) Mechanical errors.
(c) Electrical defects.
(d) Spring errors.
(e) Unbalancing.

(*a*) *Temperature Errors.*

The principal effects of temperature changes are upon the resistance of the electrical circuits and upon the directive force exerted by the springs. In modern types of instruments, by the use of special alloys in the construction of the parts, these effects are reduced to a minimum, while by proper proportioning, the residual temperature characteristics of the springs are neutralized by those of the electrical circuits, so that under ordinary conditions, temperature effects in the use of reputable instruments may be neglected. It is well, however, to avoid sudden changes of temperature in testing work, and where measuring equipment has been exposed to such, the possibility of temperature error will be greatly reduced by allowing all parts of the instrument and its accessories to reach a uniform temperature before making use of the readings.

Instruments which for their operation depend upon changes in temperature of internal parts, such as thermal ammeters or the Lincoln demand meter are carefully compensated, so that gradual changes in the temperature of the device as a whole do not affect the reading.

(*b*) *Mechanical Errors.*

Under this head may be considered scale errors and those due to friction and backlash in the moving parts. The first, due to the marking of the scale not being in agreement with the quantity measured is likely to be present to some extent in almost any instrument. As long as this error does not change, and its value is known and recorded it need not be considered as an error.

Friction may exist in the bearings due to worn or damaged jewels or pivots or it may be present at other points. Friction due to rubbing of the pointer on the scale or to small particles of foreign matter in the air gaps or damping chamber generally has the effect of making the indications so erratic as to call immediate attention to the trouble and to make the instrument useless until the trouble is removed. Friction in the bearings usually manifests itself in a sluggishness of action and a distinct uncertainty of zero. Backlash is due primarily to loose fits in the working parts of the instrument, and is sometimes very difficult to detect unless the meter be checked against a standard instrument, when this effect will become evident in a failure of the readings to agree when two checks are made, one going up the scale and the other down. Errors due to backlash and to bearing friction may be materially reduced by a gentle tapping or vibration of the meter while readings are being taken.

Errors due to bent pointers are quickly detected by a lack of parallelism between the indicator and the scale markings. Such errors should be rectified, not by readjusting the zero but by straightening the pointer.

(*c*) *Electrical Defects.*

By "electrical defects" is meant

such defects as may develop in the electrical circuits of the instrument subsequent to assembly and test. These are of a variety of kinds; they may take the nature of loose conductors, partial or complete short circuits or grounds, bad connections and open circuits.

Loose conductors are not likely to be found in well built instruments, but cases are on record where a coil or a heavy lead carrying current has been insufficiently supported, permitting it to change its position under operating conditions. In such cases it is readily understood that no degree of permanent accuracy could be expected from the instrument in question.

Short circuits in operating coils are a fertile cause of trouble. The current coils in ammeters and wattmeters, either through mishandling or static discharge sometimes develop short circuited turns which may give rise to very deceptive and elusive results. The natural tendency of a short circuited turn will, of course, be to weaken the operating torque, to which fault may be added a change in the proportionality of the scale. The short circuit may be of an intermittent nature, changiing its performance with the slight expansion as the circuit of the meter changes its temperature. Probably the most troublesome of all short circuits which can occur in an instrument is a short in the moving coil of a voltmeter or wattmeter. Here the total resistance of the circuit is but little altered, while the directive force may change immensely and usually in a very erratic way. Such a defect demands attention from an expert instrument builder and frequently requires the installation of a complete new moving element. The effect of grounds in the instrument circuits varies, of course, according to the point at which the ground occurs. In some instances, an accidental ground produces no effect until a second ground takes place, while in others, all the symptoms of a partial or complete short circuit may be in evidence.

An open circuit usually, though not always, manifests itself in a failure of the instrument to give a deflection. In some types of instruments the moving coil is paralleled by a shunt circuit, either for the purpose of adjustment or for reducing temperature or frequency errors; and, this circuit becoming open, there is a likelihood of the pointer receiving an abnormal deflection. Open circuits in the main series resistor of a wattmeter or voltmeter result in a failure to deflect, while shorted turns tend to increase the reading. Sometimes, due to poorly soldered joints or to corrosion, an abnormally high resistance contact will develop, with a resultant error, and, if in a current circuit, local heating. These electrical defects can usually be detected only by observation of the instrument for erratic action and when detected, usually require a careful and complete repair before the instrument can again be considered reliable for service.

(*d*) *Spring Errors.*

Age, continued stress and temperature changes have their effect upon the springs of indicating meters. The effect of aging is seen in a gradual

"drift" of calibration as the instrument is checked from time to time. Stressing of the spring material takes place whenever the pointer is deflected from its zero position and in some instruments there may be noted a tendency to read high on zero for a few minutes after a long-continued deflection, the pointer gradually sagging back to the original zero position. This is commonly known as "spring fatigue" and should not be confused with zero trouble from faulty jewels or pivots. In well made instruments the springs receive in the factory such treatment as serves to make these effects negligible under ordinary conditions. When springs have become strained owing to unskilful manipulation or overheated by abnormal current flow, there may be introduced into the operation of the instrument errors which will be of considerable magnitude and very erratic in their nature. The effect of temperature changes has already been treated, these usually being reduced to a minimum and the reside compensated out.

(c) *Unbalancing.*

Portable indicating instruments are usually intended to be used with the shaft in a vertical position. Unless the element is perfectly balanced and the bearings closely fitted, deviations from this position may affect the accuracy of the indications. If the element be out of balance, tilting of the meter will cause a change in the zero position. A perfectly balanced instrument should show the same zero, no matter in what position it is placed. Errors due to unbalance may be made to disappear by levelling the instrument with the shaft truly vertical. If the fit of the bearings of the instrument is not snug there is a possibility of a certain degree of side-play in the movement, which will change with differing degrees of tilt. The operating torque of the instrument itself may also produce sufficient side-thrust to deflect the shaft from one side of the jewel to the other. In such cases there will be noted a sudden change of accuracy, due to the new position occupied by the movement in the field, as the critical point is passed, and this "kink" in the calibration curve will change its position with very slight alterations in the degree of slope of the shaft. In the instance of portable polyphase wattmeters, where the directive force is derived in varying proportions from two elements on the one shaft this condition may give rise to very considerable errors even in well levelled instruments. The only cure for this trouble lies in a careful fitting of the jewels, so that side-play is reduced to an imperceptible quantity.

II. Errors Due to the Method of Measurement

The most common and greatest errors in electrical metering are those due to the method of measurement. It very often happens that errors and discrepancies arising in electrical tests are blamed on the equipment used where the real trouble lies in the way in which the instruments are employed. These sources of error may be subdivided as follows:

(a) Errors due to power losses in the measuring equipment.

(b) Errors due to neglect of outside conditions.

(c) Errors due to stray magnetic

fields and electrostatic charges.

(d) Errors due to poor contact in instrument connections.

(a) Errors Due to Power Losses.

When measurements of small electrical quantities are to be made, it becomes important to avoid (or correct for) errors which may be introduced by the power required to operate the instruments. For example, the ordinary wattmeter can be connected to measure a load, either with the voltage circuit in parallel with the load, or with the voltage circuit connected to the "line" side of the wattmeter. In the first case the indication of the instrument includes the power taken by the voltage circuit, and in the second that consumed in the current coil. Similar conditions arise in many instances where several instruments are used in a given measurement, as in the determination of resistance or of power factor. The magnitude of these losses may vary from 2 to 10 watts per instrument.

Compensated wattmeters are provided with an auxiliary winding, which, when the instrument is properly connected into circuit, does away with the necessity of correction for voltage coil losses. Such accessory circuits are not regularly provided for ammeters or voltmeters, and in the simultaneous use of several instruments a careful survey should be made of the circuit to determine whether or not the instrument losses may be neglected. The best method of connection will depend upon conditions of the test. The instruments should be so wired that if corrections are necessary their value may easily be determined and applied. It may be noted that while the reading of wattmeter is the algebraic sum of the several blocks of power which go to make up the total load measured, the rule does not necessarily apply to voltmeters and ammeters on alternating current circuits. The drop across a meter current coil may not be in step with the voltage across the terminals of the circuit, and the current consumed by a voltmeter may be out of phase with the current in the circuit across which the voltmeter is connected. Again, it is not a safe practice in the measurement of small electrical quantities to connect one instrument in circuit while it is being read and then disconnect it while reading another. The current or voltage consumed by the instrument may have affected conditions in the circuit so that the quantity indicated by that instrument will not be in agreement with the value of that quantity when the instrument is disconnected from the circuit. In such cases special methods of compensation are usually necessary.

(b) Errors Due to Neglect of Outside Conditions.

It sometimes happens that one is so engrossed in the actual metering features of his test that he neglects external conditions which may have an important bearing upon his results. Probably the most noticeable of these are temperature changes, humidity, vibration, and in some cases barometric pressure. Any or all of these may have appreciable effects upon the electrical characteristics of the apparatus under test. Due cognizance should therefore be taken of any possible errors from these causes and means

provided either to remove them or to make proper allowance for their presence.

(*c*) *Errors Due to Stray Fields.*

A very common and perhaps one of the most neglected sources of instrument error is the stray magnetic field. Such fields are everywhere present about electrical apparatus and the tester should continually be on the watch for them. With different types of instruments, the effects of stray magnetic fields vary in their nature and magnitude. Some types, while but little affected themselves, may be responsible for strong fields which disturb other meters in the vicinity, while others, not themselves of a disturbing nature, are very sensitive to external influences.

Instruments of the permanent magnet, (D'Arsonval type) have very strong fields, of their own, but are not noticeably troubled by external weak fields. However, the field from a dynamo or from a nearby permanent magnet may produce noticeable, and possibly lasting effects on the accuracy. Two meters of this type in close proximity may affect each other's indications by several per cent., and to be sure of eliminating such errors the instruments should be placed from twelve to eighteen inches apart. Powerful alternating fields, while not directly affecting the indications of D'Arsonval instruments, may permanently weaken the magnets and destroy the original accuracy.

In instruments of the electrodynamic type, the indications will be affected only by stray fields of the same periodicity as the currents in the meter coils. Permanent magnets, therefore, only affect the readings when the meters are used on direct current. These instruments are extremely sensitive to stray fields, and if not shielded should never be used without first testing for such. A simple test may be made by reading the meter in one position, turning it through ninety degrees in a horizontal plane and repeating the reading upon the same quantity. If the indications differ, stray fields are probably present, and if the error is of sufficient magnitude it must be compensated for by averaging reversed readings. In meters of the shielded type, the protection against all ordinary fields is usually sufficient, but on direct current, where electrodynamic instruments are used, reversed readings should be taken to eliminate the possibility of error due to residual magnetism in the material of the shield.

Induction type instruments are affected only by extremely strong fields of the same periodicity as the quantity under measurement and seldom require compensation. When such fields are suspected or known to be present their effect may be eliminated by taking reversed readings.

The action of stray magnetic fields upon instruments of the moving-iron type is somewhat complex. The torque upon the meter shaft is a function of the total field acting upon the iron, irrespective of frequency, etc. Such a meter, therefore, measuring alternating current may have its readings disturbed by fluxes produced by currents of the same or other frequencies, or by permanent magnets. Fields synchronous with the quantity measured may either increase or decrease

the indication, while the general tendency of others is to increase its value. The effect of synchronous fields may, as in other models, be eliminated by taking reversed readings, but the only way to avoid the effect of the others is to guard against their presence.

Sources of stray magnetic fields are much more common than might at first be expected. Among them may be entioned: Permanent magnets, such as are found in the D'Arsonval meters, magnetically damped instruments, meggers, watthour meters, magnetos and telephones; conductors carrying heavy currents in proximity to the instruments in use; transformers with open, poorly assembled or highly saturated iron; dynamo-electric machinery, both for direct and alternating current; circuits in nearby instruments and magnetized tools.

While the above has reference to magnetic fields only, there are times when serious errors may be introduced by electro-static fields. The best known instance of this is of course the effect which may be produced upon the pointer by a static charge induced upon the glass of the instrument by rubbing with intent to remove dust. This must be carefully guarded against, particularly in dry weather, and, where suspected, may be removed by breathing upon or by slightly moistening the glass. In wattmeters, where there are two circuits which may have widely different potentials, there are sometimes effects due to the electrostatic attraction between the fixed and movable parts. Care should always be exercised to avoid excessive potential differences between such parts, and wherever practicable, the two circuits should be electrically connected at some point. In all cases where possible, the manufacturer's diagram should be followed in the connection of wattmeters, which will generally assure the user that the operating parts are at approximately the same potential.

(*d*) *Errors Due to Poor Contacts.*

Care should always be exercised to see that there are no loose connections in the metering circuits. This is particularly true where large currents or low voltages are concerned. Loose connections carrying large currents will soon manifest themselves by undue heating. This should be particularly guarded against where shunts or meters carrying the line current are involved, as the high temperature may permanently affect their accuracy. The meter leads on shunted ammeters should always be carefully connected in and tightened up, the terminals being kept clean and bright. Shunt leads are usually made of stranded wire and the breaking of a few strands of this wire will seriously impair the accuracy of the instrument. Such leads should always be carefully handled and never kinked sharply or unduly stressed. Too much care can not be observed to see that the strands of these leads are intact, and when found defective,. they should be at once repaired. Shunt leads should be always used with the instrument for which they are adjusted and should not be used for any other purpose. The secondary circuits of current transformers should be made up of good wire of low resistance, and particular care should be exercised in the

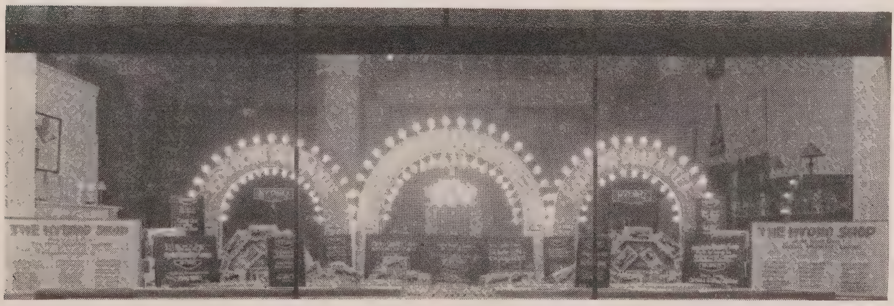
connections. "Test clips" should never be used in these circuits. The introduction of abnormal resistance or of open circuits into current transformer secondaries is dangerous not only to equipment but to the operator. Whenever possible the secondaries of current transformers should be short circuited at the transformers except when observations are being made. The subject of errors arising in instrument transformers will be treated in a subsequent article.

III. Errors of Observation.

Errors arising from the method of reading of the instrument are exceedingly variable and depend upon two factors, the construction of the instrument and the skill and care of the operator. High grade portable instruments are provided with a mirror beneath the pointer. With these, the reading is made by observing with one eye the position of the pointer at the time it either hides its own reflection or splits the reflection of the observer's eye. If the pointer be twisted, and repair is for any reason not practicable, the readings may be made by selecting one convenient point or edge near the tip and using that in all observations. In instruments which are not fitted with the mirror, readings should be made with the eye, as near as can be estimated, on the axial line of the movement.

Mistakes are sometimes made in the use of instruments having several ranges by reading the wrong scale or by allotting wrong values to scale divisions. These can be obviated only by proper care on the part of the user.

In any series of measurements of the one quantity we find that, owing either to imperfections in the instruments or to personal errors in making observations, results will differ slightly from one another. Errors of observation are as likely to be positive as negative, and, if a sufficient number of readings are taken, may in the long run be considered as having little influence upon the final result. The greater number of individual observations, the less will their mean deviate from the true value. Operating conditions and the degree of accuracy desired will in each case determine the number of observations to be made.



Window Display, London Hydro Shop

HYDRO NEWS ITEMS

Central Ontario System

The by-law authorizing the issue of debentures for the purpose of erecting a new municipal substation in Peterboro at an estimated cost of $150,000, was passed on March 20th. This work has been under consideration since 1916, but, due to war conditions, was postponed. The load in Peterboro is now 5,300 h.p.

* * *

Additional electric heaters were installed in the two one-man cars operated by the Peterboro Radial Railway. The heating is now much improved.

* * *

Improvements to the local system in Bowmanville are planned for this season, and estimates are in preparation for a change in the voltage from 2,300 v. delta to 4,000 v "Y."

* * *

Negotiations have been re-opened on the supply of lighting service to summer residents at Presqu'Isle Park, near Brighton.

* * *

The programme of reconstruction of overhead lines in Lindsay will be completed this season. The work done last year made things easy for the maintenance men this winter.

* * *

The Public Utilities Commission of Kingston has purchased a site for an office building adjacent to the substation, at a price of $15,000.

* * *

The active canvass in Haldimand Township has resulted in a large number of contracts being signed.

* * *

Extensions of the system already constructed in Kingston Township are proposed. The anticipated load justified a three-phase feeder at 4,000 volts. The new area takes in the hamlets of Westbrook and Collin's Bay.

* * *

Eugenia System

The Commission is calling for tenders for a second pipe line at the Eugenia Development. This second pipe line will serve two purposes: First, it will enable the Commission to increase the output of Eugenia Development to approximately 8,000 horse-power, and, secondly, it will enable maintenance and repairs to be taken care of on the existing pipe line without inconvenience to the various municipalities being served from the system at large. The installation of this second pipe line will also enable the Commission to use the water with greater efficiency. No changes are required in the Power House to increase the present output to 8,000 horse-power, as the hydraulic and electrical generating and

switching equipment is already in service.

* * *

Muskoka System

The Commission is investigating at the present time an extension to the Muskoka Development in the nature of additional generating equipment for the purpose of providing for the growing demand of the Muskoka System as well as to provide additional power for the Severn and Eugenia Systems. It is proposed to construct a tie line from the Muskoka Plant to Waubaushene or Coldwater on the Seven System, crossing the Severn River at the location of the Orillia Development at Swift Rapids. Thus, the Muskoka System with a total capacity of from 5,000 to 6,000 horsepower would be operated in parallel with the Orillia Plant at Swift Rapids and the Wasdell, Big Chute and Eugenia Generating Plants of the Commission. As soon as the investigation is completed and has received the approval of the Commission the matter will be taken up further with the municipalities.

* * *

Niagara System

The Village of Sutton is preparing to submit Hydro by-laws, and it is expected that lines will be constructed to supply this municipality in the early spring, so that power may be available to take care of the summer cottage business in the Lake Simcoe district.

* * *

A contract has recently been made with the H.O. Cereal Company for power supply for its plant at Ayr. The company is arranging to install electric furnaces to take care of the roasting of the cereal called Force. This will be the first time the electric furnace has been used for the roasting of the cereal, gas furnaces being used entirely heretofore.

* * *

The Commission is giving assistance to the Paris System to arrange for additional sub-station capacity.

* * *

Plans are now being prepared by St. Catharines Public Utilities Commission for a new outdoor type substation. This sub-station will be of the most modern type and will consist of outdoor type transformers and switches with indoor control.

The question of changing the entire St. Catharines system from 2,200 to 4,000 volts is also being considered.

* * *

Arrangements will shortly be made to improve the service on the Mimico Division of the Toronto & York Radial Railway by the installatian of additional rotary converter equipment. The more frequent service now being supplied requires additional power for this Division.

* * *

Nipissing System

The Commission have recently approved expenditures covering additional equipment at Bingham Chutes so as to bring this development up to an output of approximately 1,200 horsepower. At the same time approval has been given covering the installation of a new pipe line at the Main Generating Plant near Nipis-

sing, as well as overhauling No. 2 Unit so as to bring the capacity of the original generating station up to approximately 1,800 horsepower.

* * *

Rideau System

The municipal steam plant at Smiths Falls is still in operation. This is being operated temporarily by the Commission, in order to meet the shortage of power on the Rideau System. About 200 K.W. is being obtained from this plant.

* * *

A suit for $49,000 damages is being brought against the Village of Kemptville by the Kemptville Milling Company. The trial will take place at Perth on April 9th.

* * *

All municipalities on the Rideau System have completed the year 1922 with large surpluses.

* * *

St. Lawrence System

A request has been received from the Town of Hawkesbury for estimates to supply this municipality with 1,000 to 2,000 horsepower from an extension of the Cornwall-Alexandria 44,000 volt line. This municipality is in the extreme easterly part of the Province. Additional power is required to meet the increasing demand for industrial requirements.

* * *

The plant in the Town of Cornwall formerly operated by the Cornwall Pulp & Paper Company has been taken over by the Glengarry Pulp Company, which commenced manufacturing pulp in the early part of February, taking about 1,500 horsepower from the St. Lawrence System.

* * *

A modern creamery has been erected in the Town of Alexandria which will be operated by electric power from the Alexandria System.

* * *

A Rural extension has been completed between Lancaster and South Lancaster, to supply rural residents in this district.

* * *

Mr. J. A. Johnston, Manager of the Brockville Public Utilities Commission has tendered his resignation and has joined the staff of the Eugene F. Phillips Works, Ltd., as sales manager. Mr. Johnston has been intimately associated with this company for the past two years, on account of the company's decision to remove its plant from Montreal. Brockville was fortunate in securing the company, and a great deal of credit is due Mr. Johnston in his work connected with this. It is with regret that we learn of Mr. Johnston's decision, but we wish to extend to him our very best wishes.

Mr. A. L. Farquharson has been accepted by the Brockville Public Utilities Commission to fill the vacancy caused by Mr. Johnston's resignation. He was the choice of the local commission from a large number of applicants, and will take his new duties at once. Mr. Farquharson takes up the work as an experienced man, well qualified and highly recommended. He is a supporter of Hydro principles, and public ownership. He recently left Fort William, where he

had been in charge of public utilities for 14 years.

* * *

Wasdell System

Arrangements have been completed for constructing rural lines in Mariposa Township to be served from a substation located at Pinedale on the main transmission line between Cannington and Greenbank. Arrangements have been completed for beginning construction work as soon as weather conditions allow in the spring. It is anticipated that service will be inaugurated in this district early during the coming summer. Included in the Mariposa District are the Police Villages of Little Britain and Oakwood, both of which will receive service, together with neighboring farms. Contracts signed to date number 36 farms, and 60 hamlet customers.

* * *

The Hamlet of Victoria Road, located adjacent to the Village of Kirkfield, has been recently connected to the Wasdell System from the Kirkfield substation. Approximately 18 domestic and commercial lighting customers and one power customer are receiving service.

* * *

To End Fuse Doubt For Customers

The Empire Gas and Electric Company at Geneva, New York, is having its service supervisors, who inspect appliances and look up new business on customers' premises, also check up the electric lighting circuit locations.

When there is more than one circuit on the premises this combination "inspector-salesman" checks out each circuit to see which set of fuse plugs it is connected through.

In the case of a two-circuit building, if circuit No. 1 serves the first floor and the basement, and circuit No. 2 serves the second floor, a sticker is placed under circuit No. 1 cutout, stating:

"These are the fuses to be replaced in case the first floor and basement is without current."

Then another sticker is placed under the cutout in circuit No. 2, stating:

"These are the fuses to be replaced in case the second floor is without current."

This will save many service calls to the company's office to renew fuses, and will save the consumer needless expense and worry, and will make it unnecessary for him to be without service for a long period on account of fuse trouble.

It is confidently expected that this method of extending the service of the electric light and power company will fully repay the company in good will for the effort it requires.—*Electric Light and Power.*

* * *

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CONTENTS

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APRIL, 1923

The Hydro Electric Movement in Ontario

On October 11, 1910, the first delivery of hydro-electrical power from Niagara Falls by the Hydro-Electric Power Commission of Ontario, was made. During that year a total of nine municipalities were served, taking a total load of 750 horse power. In 1922, 544,000 horse-power were delivered, being distributed in 242 urban municipalities and 74 townships, 335,000 consumers receiving service.

The various systems operated by the Commission have been extended until they cover the greater part of the southern portion of the Province. The growth of the service is outlined in the last of a series of articles covering The History of the Hydro-Electric Power Commission. The results obtained are beyond anything anticipated by those who at an informal meeting twenty years ago first discussed the possibility of municipal co-operation in the distribution of hydro-electric power.

* * *

Every Utility should be a Member

From time to time there appear in the Bulletin, reports of activities of the Association of Municipal Electrical Utilities of Ontario. Each year this organization gives every municipally owned electric utility in the Province of Ontario an opportunity for becoming a member by sending out statements showing the amount of annual dues each utility should contribute towards the support of the Association as a member.

The general response of the utilities has been very gratifying, but there are yet a considerable number who have not identified themselves with

the Association. For the benefit of those who are not members and are not therefore familiar with the Association we would quote from its Constitution and By-laws.

"This organization............is organized for the following purposes, to wit:

"1. To further the interests of Municipal Electric Utilities in Ontario............"

"2. For the mutual assistance of its members, education along technical and commercial lines, and the standardization of methods, apparatus and materials."

Those who have read the various reports of the activities of the Association must realize that it is an organization that is endeavoring to fulfil its mission and is doing real work. The reports of meetings, however carefully prepared, cannot do full justice to them, and anyone reading those reports cannot hope to obtain the same benefits as from attending the meetings. It is only by becoming members of the Association and entering into its activities that the maximum benefit can be expected.

There are throughout the Province many utilities that cannot for sufficient reasons be represented at the meetings of the Association. This should not be taken as a sufficient reason for not becoming members. The Association wishes to help all, whether they are represented at conventions or not. The list of officers shows that the Province is laid out into five districts, and each district is represented by one Director. These directors are not intended to be representatives from those districts on the Executive Committee only; their duty is also to act as messengers between the Association and those utilities in their districts that are unable to attend conventions.

There is no municipally owned electric utility in Ontario that can afford to neglect becoming a member of the Association. It is strongly recommended that those who have not taken out membership for the present year do so, and enter into it whole-heartedly. By co-operation results can be obtained when individual effort would accomplish little.

A. M. E. U.

Summer Convention at Orillia.

June 13, 14 and 15, 1923.

History of the Hydro Electric Power Commission

No. 5 (Concluding)

The Development of the Systems

WE have now come to the last of our series of articles giving a brief outline of the History of the Hydro-Electric Power Commission of Ontario. It remains for use to show how the co-operative scheme of the distribution of electrical energy has worked out in each of the systems now operated.

Niagara System

Instead of undertaking the construction of a plant to generate the power required by the municipalities to be served from Niagara Falls, it was deemed more advisable to purchase it from one of the companies already existing who were making provision to handle loads considerably greater than they had immediate prospects of obtaining. Tenders were asked for accordingly, of which, that of the Ontario Power Company was accepted. An agreement was prepared which was signed on March 19th, 1908. By this agreement the Commission was to receive power from the Ontario Power Company at 12,000 volts at $9.40 per horsepower per year until the load reached 25,000 horsepower. When the load exceeded this amount the rate became $9.00 per horsepower per year and was to apply up to the limit of the contract, viz.: 100,000 horsepower. The agreement also provided for the delivery of power at 60,000 volts at $1.00 per horsepower per year higher than the 12,000 volt rate. The Commission, however, decided to use a transmission voltage of 110,000 volts and had its equipment designed to receive the power at 12,000 volts, thereby getting the lower rate. The first delivery of power under this agreement was made on October 11th, 1910. The load taken during that month was 750 horsepower.

After a couple of years of operation it became evident that the full amount of the Commission's 100,000 horsepower contract with the Ontario Power Company would soon be entirely absorbed, and it became necessary to ascertain whether a further supply of power might be obtained. As a result of careful investigation of the various schemes that had been proposed from time to time by experts for the development of power at Niagara Falls, and of surveys made by the Commission's own engineers, it was decided that the best plan would be for the Commission to have its own development works and generate power on a large scale. This proposal was laid before the Provincial Government in 1913 and

powers enabling the Commission to go ahead with the plans were obtained in 1914. It was not until 1917 that authority was given under the Ontario Niagara Development Act and work was commenced on what is known as the Queenston-Chippawa Development.

Meanwhile, the demand for power had grown so rapidly that in 1915 it was necessary to purchase a temporary supply of 16,000 horsepower from the Toronto Power Company. In 1916, 50,000 horsepower additional was obtained from the Canadian Niagara Power Company. This was all utilized by January, 1917. In August, 1917, the Commission purchased the capital stock of the Ontario Power Company, and in so doing obtained an additional 10,000 horsepower which had previously been exported. In 1919, the Commission completed the construction of a third pipe line and installed new equipment which increased the generating capacity of the Ontario Power Company's plant by approximately 40,000 horsepower. The contract with the Canadian Niagara Power Company was extended to 59,000 horsepower at the end of 1919. By the end of 1921, the Commission found it necessary to purchase additional power at Niagara Falls under day-to-day contracts to the extent of 90,000 horsepower. In 1920, the Commission, in conjunction with the City of Toronto, arranged for the purchase of the Toronto and Niagara Power Company and its subsidiaries including the Electrical Development Company with its generating plant of 126,000 horsepower capacity at Niagara Falls. This purchase known as the "clean-up deal" was recently completed and ratified.

The Queenston-Chippawa Development, which was put into commercial operation early in 1922, involved the construction of a canal about 12¾ miles long, running from that point above the Niagara Falls at which the Welland River joins the Niagara River, down to the power station site, near Queenston. For 4¼ miles the canal consists of the Welland River channel, widened and deepened where the direction of the flow is reversed. The remaining 8½ miles are carried across country through a cut. A total of 13,500,000 cubic yards of earth and 4,000,000 cubic yards of rock were excavated in the execution of this project. By this development an effective head of 305 feet is obtained, the total difference in levels of Lakes Erie and Ontario being 327 feet. The effective head thus obtained is about twice that utilized by the plants located at the Falls. This means that the efficiency of utilization of the water diverted from Niagara Falls has been doubled, and for each cubic foot per second, instead of 15 horsepower, approximately 30 horsepower is now developed.

The new plant was formally opened on December 28th, 1921, when the first unit commenced operation. This unit of 55,000 horsepower comprises the largest single runner hydraulic turbine ever built, coupled to a generator of 45,000 k.v.a. capacity. Three other units of the same size were installed and placed in operation during 1922, while a fifth has just been com-

pleted. This will complete the initial development of 275,000 horsepower. Three additional units have been ordered, each to have a capacity of 55,000 k.v.a. The first of these will be ready to help carry the peak load at the end of this year while the other two are to be working about the end of the year 1924. The power from these generators has been absorbed as rapidly as it has become available. The present canal is large enough to permit the development of about 600,000 horsepower.

The agreement between the Ontario Power Company and the Commission having been signed covering the supplying of electricity to the Commission at Niagara Falls, contracts dated May 4th, 1908, were entered into between the Commission and fourteen municipalities. These called for the delivery of a total of 26,235 horsepower in an area extending from Toronto in the East to London and St. Thomas in the West, Stratford and Guelph being the most northerly points. The Commission then commenced the construction of a 110,000 volt transmission system with transformer and interswitching stations for the delivery of the power. These included a step-up transformer station at Niagara Falls where the power was received by an underground system from the Ontario Power Company at 12,000 volts and transformed to the transmission voltage. At Dundas an interswitching station was built, from which lines were carried to Toronto, to Guelph and to Woodstock. Transformer stations to step the power down to voltages at which it was to be delivered were constructed at Toronto, Guelph, Preston, Berlin (now Kitchener), Stratford, St. Mary's, London, St. Thomas and Woodstock. The delivery of power commenced on October 11th, 1910, when it was officially turned into the Berlin System by the late Sir James P. Whitney. Nine municipalities commenced receiving power during that year.

From the time that it became apparent that the transmission of electricity from Niagara Falls under a municipal co-operative scheme was to become a reality, other municipalities began to join in with the original fourteen. The 110,000 volt transmission lines had to be increased in capacity and extended west as far as Windsor. Additional transformer stations had to be built at Cooksville, Chatham, Brantford, Windsor and York, and an extension made to the Dundas interswitching station to house transformers to serve Hamilton and other municipalities in that district. The growth of the Niagara System is shown in the following tabulation. It will be noted that the load has doubled in the last six years and increased over seven times since 1912. The amount of power received by the municipalities is somewhat greater than the figures given, owing to diversity. These statistics do not include power sold by the Ontario Power Company to its other customers, which in November, 1922, amounted to 123,261 horsepower, or by the Toronto Power Company. Service from the System reaches to a population of over 1,100,00 people in Ontario.

Year	Power Generated H.P.	Towns etc.	Townships	Companies	Total	Consumers
1910	750	9	0	0	9	....
1911	18,072	23	0	4	27	....
1912	37,720	33	0	7	40	....
1913	50,478	40	7	12	59	52,245
1914	82,161	61	10	15	86	78,925
1915	106,154	83	15	18	116	99,495
1916	144,123	101	18	21	140	124,973
1917	239,761	111	24	22	157	140,178
1918	250,190	115	25	24	164	150,207
1919	264,872	118	26	25	169	174,989
1920	282,791	123	26	27	176	200,825
1921	317,837	127	34	29	190	218,292
1922	425,230x	135	55	31	221	....

xNovember

St. Lawrence System

During 1910, 1911 and 1912, various municipalities on the St. Lawrence River entered into negotiations with the Commission for a supply of electricity. Resolutions were received from many of these municipalities, including Prescott, Brockville and Kingston. Later requests were received from Williamsburg, Winchester, Chesterville, Russell and other municipalities.

These negotiations finally led to the Commission entering into a contract with the New York and Ontario Power Company for the delivery of power from a proposed development at Waddington, N.Y. This contract provided for the delivery of various blocks of power at various rates ranging from $14.00 down to approximately $11.00 per horsepower per year. The Company proceeded to get rights to develop power on the St. Lawrence River, but in this connection met with difficulty, and permission was finally refused by the Dominion Government. Pending the negotiations with the Dominion Government, the Company arranged, under the name of the Rapids Power Company to get delivery of power from Morrisburg. The Company got into controversy and difficulty with the municipality of Morrisburg, so in April, 1915, changed the point of delivery to Iroquois, where power was obtained from the Beach Company, who had 500 horsepower available. After one year the Company made an assignment and the Commission took over the sub-station property at Iroquois and continued to take power from the Beach Company for three years.

During the period when the Commission was obtaining power from the Beach Company, investigations were being made in the eastern part of the province to obtain a knowledge of the amount of power needed in the entire district, including the municipalities on the Rideau System. As a result of these investigations, the Commission decided to obtain power at Cornwall and an agreement was entered

into with the Cedar Rapids Company, for the delivery of power at $15.00 per horsepower per year at 110,000 volts. Construction was proceeded with in 1918 to permit of delivering power from this point to the St. Lawrence System. A transformer station was constructed at Cornwall, and a transmission line connecting this point to the lines at Morrisburg was built. The supply from the Beach Company's plant at Iroquois was discontinued and the municipalities began to receive power from the Cedar Rapids Company on May 1st, 1919.

On July 26th, 1912, the towns of Brockville and Prescott entered into agreements to take power and the Commission proceeded to construct lines to transmit it from Morrisburg. Winchester also signed an agreement before the close of that year and Chesterville in the following July. Since that date a number of municipalities have been added to the System while more are considering entering the scheme. Owing to the long distances between the various towns, and the small amounts of power that many of them require, it is very difficult to extend to all of the municipalities desiring service. Even though the System has been handicapped on account of natural conditions, yet it has been extended to serve ten towns and villages having over 20,000 population, and a number of rural districts and companies.

Rideau System

During the years 1916 and 1917, while the Commission was investigating the power requirements of the eastern end of the province, with the view of uniting the municipalities under one general scheme, communications took place between Perth, Smith's Falls and Carleton Place regarding obtaining Hydro power. The municipalities held that the local plants were not of sufficient capacity to supply the future needs of those towns, as required by the extension of their industries. The requirements of this district were considered concurrently with the requirements of the St. Lawrence System, which at that time had no adequate source of supply. The results of consideration in this connection led to a conclusion that the best way to supply these municipalities would be to develop the local water powers. Negotiations were at once taken up with the owner of the High Falls development on the Mississippi River and this property was purchased.

The development of High Falls was proceeded with during 1919 and 1920, the first delivery of power from this plant being made in May of the latter year. The Commission also arranged to purchase power, under a ten year contract, from the Rideau Power Company at Merrickville, and the municipalities of Smith's Falls and Perth received service from this point until the High Falls Development was ready. Since the completion of the High Falls plant the service has been extended to include Lanark and Kemptville along with the three original contracting municipalities.

Severn System

The first municipalities served by the Commission on the Severn System were Midland and Penetanguishene, the former being connected in October, 1911, and the latter in November of the same year. Power was purchased from the Simcoe Railway and Power Company at a sub-station in Midland at 2,200 volts for Midland and at 22,000 volts for Penetanguishene, and a transmission line was constructed from the Midland sub-station of the Power Company to Penetanguishene.

The Simcoe Railway and Power Company at that time generated power at the Big Chute Development on the Severn River, and had a transmission line serving the Midland sub-station. In February, 1913, the municipalities of Coldwater, Barrie and Collingwood were connected to the System, power for these municipalities being purchased from the company at Waubaushene. Transmission lines from Waubaushene to the sub-stations located in these municipalities were constructed by the Commission on behalf of the municipalities.

On July 1st, 1914, the Simcoe Railway and Power Co.'s development at Big Chute with the transmission line and sub-station at Midland were taken over by the Commission on behalf of the municipalities. At the January elections in 1917, the municipalities submitted by-laws to the ratepayers, enabling the various Councils to execute new agreements with the Commission so that the various municipalities could come in on a partnership basis and assume their proportionate share of the development, the transmission line and the sub-station purchased by the Commission from the Simcoe Railway and Power Co. on their behalf. In 1918 and 1919 an extension was made to the Big Chute Development to provide for the growing loads in the various municipalities. The transmission line between the Big Chute and the development at Swift Rapids, owned by the Town of Orillia, was purchased by the Commission in 1916 for the purpose of transmitting power from the Swift Rapids Development and from the Wasdell's development to the Seven to be used as a stand-by and in cases of emergency. A tie line was also built in 1916 between the Severn and the Eugenia Systems, enabling these two systems to be operated in parallel.

The lines of the Severn System have been extended to the extreme southerly limits of Simcoe County and serve a total of seventeen towns and villages with a population of about 35,000 people in addition to rural extensions and companies.

Eugenia System

The Eugenia Development is located on the Beaver River near Flesherton in Grey County. This development was made to serve the municipalities in Grey and Dufferin Counties. The transmission lines have been extended until it also includes Bruce County and sections of Wellington and Huron. The Eugenia Development is owned by the Commission and was originally constructed by it. The first installation con-

sisted of two 2,000 horsepower units. During the war the capacity was increased by the addition of one unit of 4,000 horsepower capacity. The development was first placed in operation in 1915 when Owen Sound, Chatsworth, Flesherton, Durham, Mount Forest, Dundalk and Shelburne received service. Other municipalities have been added from time to time; there being now a total of twenty municipalities with a population of about 38,000 people, in addition to rural extensions and companies. The Eugenia plant operates in parallel with the Big Chute Development, there being a tie line between the Eugenia power house and Collingwood.

Wasdell System

The Wasdell Development is located on the Severn River a short distance north of Lake Couchiching. This development is owned and was originally constructed by the Commission. It was placed in operation in October, 1914, when service was commenced to Beaverton, Brechin, Cannington, Woodville and Sunderland. Two sub-stations were constructed, one being located at Beaverton and the other at Cannington. In the fall of 1922 the transmission line was extended and a sub-station built at Greenbank, from which point Uxbridge and Port Perry are served. The plant operates in parallel with the Big Chute Development through a tie line connecting it with Orillia. On this system there are now a total of eight towns and villages with a population of about 5,500 people. Service is also supplied to rual extensions in the townships of Brock and Mara and to a power user near Kirkfield.

Muskoka System

The Muskoka Development and System originated by the Town of Huntsville and the Anglo Canadian Leather Co. making application for power. In pursuing investigations to determine the most feasible source from which to serve this load, the power plant belonging to the Town of Gravenhurst on the South Branch of the Muskoka River was chosen. Arrangements were made with Gravenhurst whereby the Commission assumed the unexpired debentures which Gravenhurst had issued to cover the construction of the development referred to above. It was also arranged that Gravenhurst would buy power from the Commission at generated voltage, and retain ownership of the transmission line between the development and the town. The development had been constructed to provide for only the requirements of Gravenhurst. The Commission had it overhauled and enlarged so as to provide sufficient capacity for both Gravenhurst and Huntsville, and constructed a transmission line between the development and Huntsville. Service was given to Gravenhurst under the partnership basis by the Commission in November, 1915, and to Huntsville who in turn served the Tanning Co. in August, 1916.

Ottawa System

The City of Ottawa was the first municipality to receive its supply of electricity through the Commission.

In July, 1907, agreements were signed between the Ottawa and Hull Power Company and the Commission and between the Commission and the City of Ottawa covering the delivery of power to the City of Ottawa up to a limit of 2,500 horsepower. During 1910 the limit set in the agreements was reached and in September of that year new contracts were signed increasing the load limit to 4,000 horsepower. In February, 1914, the amount of power taken by Ottawa had again exceeded the limit of the contract so a third agreement was signed extending the limit to 20,000 horsepower.

The amount of power taken by Ottawa has continued to increase from year to year, having reached over 12,000 horsepower. In addition to serving the city, extensions have been made into rual districts in its vicinity.

Thunder Bay System

Port Arthur first embarked in the business of municipal power development in 1901 by constructing a hydro-electrical plant in the Current River. This plant is situated within the limits of the municipality and has a capacity of 3,000 horsepower. The growing demand for power, however, soon made it necessary to provide for further supply.

The results of the activities of the various municipalities in the Niagara District and the creation of the Hydro-Electric Power Commission of Ontario, inspired the officials of the City of Port Arthur to seek a solution of its power problems along lines similar to those adopted by Niagara municipalities. In August, 1906, the Commission was approached with the view of delivering 1,000 horsepower to Port Arthur. After investigating various schemes it was concluded best, for the time being, to secure additional power for Port Arthur from the Kaministikwia Power Company who had recently installed a plant on the Kaministikwia River at Kakabeka Falls. In September, 1909, a contract was executed between the Commission and the Kaministikwia Power Company covering the delivery of power up to a maximum of 10,000 horsepower, for a period of ten years. Subsequently as Port Arthur was not ready to receive the power, the ten year period was re-fixed as beginning December 21st, 1910. Having thus contracted for a supply of power the Commission in turn contracted with Port Arthur.

The increasing demands for power in both Fort William and Port Arthur, in order to meet the requirements of the rapidly developing district, became so pronounced that the officials of the Twin Cities foresaw that the time was drawing near when the maximum output of the existing power installations would all be in use. Consequently in 1916, the Commission was requested to seek some solution whereby a suitable supply of hydro-electric energy could be procured. Studies were made of all of the undeveloped water powers in the district, which showed those of the Nipigon River as the most feasible when considering the future of the district. The necessary by-laws and legislation was finally obtained and work was commenced on the develop-

ment at Cameron's Pool on December 1st, 1918. The first delivery of power from the Nipigon Plant was made on December 20th, 1920, just as the power contract with the Kaministikwia Company was expiring.

The average load taken by Port Arthur from the Commission has grown from 1,745.6 horsepower in 1911 to 8,908.2 horsepower in 1922, which is in addition to that generated at the Current River plant.

Central Ontario System

Prior to 1908 no attempt had been made to develop the water powers of the Trent River except by individual owners or lessees at isolated points.

In that year a syndicate purchased lands and riprarian rights adjoining a number of the water power which had been made available for development by the construction of the Trent Canal dams. Leases were secured from the Dominion Government granting to the lessees the use of the surplus waters of the Trent River for the development of power at some of these sites.

In the spring of 1909 the Seymour Power and Electric Co., Limited, (the successors to the syndicate) began work on the development of the water power at Dam No. 11, formerly known as Stephens' Dam, at Campbellford. During the progress of this construction a 44,000 volt transmission line was constructed to the works of the Deloro Smelting and Refining Co., near Marmora, and a substation was built on the property of the customer. This generating station, transmission line and substation formed the nucleus of a system which quickly spread over the entire Central Ontario district.

In the years 1909, 1910, 1911 and 1912, 44,000 volt transmission lines were constructed connecting Campbellford with Madoc, Sulphide, Tweed, Stirling and Belleville; distributing systems were acquired and reconstructed in a large number of municipalities and connected with transmisison lines extending from Napanee on the East to Whitby on the West and to Peterboro and Lindsay on the North. During this peiod water powers were developed on the Trent River at Dam No. 2 (Trenton) Dam No. 5 (Frankford), Dam No. 14 (Healey Falls) and Dam No. 20 (Auburn). The developed water power at Dam No. 30 (Fenelon Falls) was also acquired and connected to the system.

A holding company, incorporated as the Electric Power Co., Limited, was formed for the purpose of holding majority interest in and control of all the subsidiary companies involved in the spread and growth of the system.

The municipalities of Madoc, Stirling and Whitby purchased power from the Company and owned and operated their own local distributing systems. The distributing system in the Village of Colborne was operated by a private owner who purchased power at wholesale from the Company. In the other municipalities where service was supplied, the local plants were owned and operated by the subsidiary companies. In addition to the electrical systems, the companies also owned and operated gas plants at Cobourg, Napanee,

Oshawa and Peterborough, waterworks plants at Cobourg and Trenton, the street railway at Peterborough, and the Pulp Mill at Campbellford.

In 1913 the City of Peterborough acquired the electrical distribution system in that city and entered into a contract with the Hydro-Electric Power Commission of Ontario under which the Commission supplied power to the municipality, purchasing it in turn from the Electric Power Co.

On March 1st, 1916, the Province of Ontario purchased from the Electric Power Co., Limited, all its assets, and by Order-in-Council of May 5th, 1916, appointed the Hydro-Electric Power Commission of Ontario as its trustee to operate the properties on its behalf.

Since that date the Commission has entered into contracts with the municipalities of Kingston, Picton, Bloomfield, Wellington, Omemee, Lakefield, Norwood, Havelock and Marmora, and service is now being supplied to consumers in all these municipalities under the Power Commission Act, the local systems being owned and operated by the municipalities and power being purchased at wholesale from the Commission.

Since 1916 the system has been greatly extended and enlarged by the Commission and the physical condition of the component parts has been brought to a much higher standard. The generating capacity of the Healey Falls station has been increased by the addition of a third unit; a new 10,000 horsepower generating station has been built and placed in operation at Dam No. 10 (Ranney Falls), and construction work is about to begin on the developments at Dams Nos. 8 and 9 at Meyer's Island below Campbellford.

Nipissing System

Prior to 1910 North Bay received electrical service from a steam generating plant operated by the North Bay Light, Heat and Power Company. Upon completion of the hydro-electric plant of the Nipissing Power Company on South River, the Light, Heat and Power Company distributed electricity, generated and transmitted to a substation in North Bay by the Nipissing Power Company. The Nipissing Power Company also extended its lines to serve Nipissing, Callander, and Powassan. The North Bay Light, Heat and Power Company and the Nipissing Power Company both became subsidiary to the Electric Power Co., Limited, the holding company of the plants in the Central Ontario System.

The assets of these two companies were placed in the hands of the Hydro-Electric Power Commission for operation, along with the other properties of the Electric Power Co., Limited, that were purchased by the Province of Ontario in 1916. Although no new municipalities have been added to the system, the increase in the load has necessitated increasing the capacity of the generating plant on the South River, and further developments are planned to be made in the immediate future.

Lighting Rates in California

IN a report* of a decision of the California Railroad Commission, schedules of rates for lighting service by the Pacific Gas & Electric Company as ordered by that Commission are given. Since the Company in question operates an extensive system, and serves a number of large cities, the rates may be considered as typical for that district. The schedules are entirely different in form from those generally used in Ontario. A brief statement of them is given herein together with a few comparisons with the lighting rates used in Hydro municipailties.

The Pacific Gas & Electric Company supplies electricity, gas, water, steam heat and street railway service. The electric service is supplied throughout an area of approximately 270 miles long by 130 miles wide, with a population exceeding 1,500,000. In San Francisco, Oakland, Sacramento, and other towns and districts, the Company operates in competition with the Great Western Power Company. The total gross revenue earned in 1921 was over $38,500,000, of which the electric properties produced nearly $23,300,000 or 61.9 per cent. Electricity is generated in 23 owned and five leased hydro-electric plants having a total installed capacity of 229,950 kilowatts, and in three owned and one leased steam plants with an installed generating capacity of 129,500 kilowatts, making a total of 359,450 kilowatts installed generating capacity as of December 31, 1921. The Company also purchases from other sources, there being approximately 15 per cent. of the total requirements purchased in 1921.

*22 Rate Research, page 275.

The system carried a maximum peak load in 1921 of 265,925 kilowatts and the total power generated and purchased was 1,489,088,657 kilowatt hours. This energy is transmitted to 238 substations over 2,774 miles of transmission lines at potentials varying from 110,000 to 17,000 volts. From these substations radiate over 7,500 miles of distribution lines, reaching more than 285,000 consumers with a connected load of over 1,000,000 horsepower. The Company also sells a large amount of energy to other corporations for resale. Approximately 20 per cent. of the Company's gross electric revenue is derived from rural business lying outside the corporate limits of cities and towns.

According to the order three fixed schedules of general lighting rates are given. One is for the congested metropolitan area of the bay district, one for other municipalities and incorporated territory on the system, and one for rural territory.

SCHEDULE L—1.

General Lighting Service—

Applicable to general domestic and commercial lighting service, including household appliances and small power service.

Territory—

Applicable to service within the incorporated limits of San Francisco, Oakland, Berkley, Piedmont, Emeryville, San Leandro and Albany.

Rate—

First 10 k.w. hrs. or less per meter per month 90c. per month.
Next 40 k.w. hrs. per meter per month 6c. per k.w. hr.
Next 150 k.w. hrs. per meter per month 5c. per k.w. hr.
Next 800 k.w. hrs. per meter per month 4c. per k.w. hr.
Next 2000 k.w. hrs. per meter per month 3c. per k.w. hr.
All over 3000 k.w. hrs. per meter per month 2.5c. per k.w. hr.

SCHEDULE L—2.

General Lighting Service—

Applicable to general domestic and commercial lighting service, including household appliances and single phase service to motors not to exceed 5 h.p. capacity.

Territory—

Applicable to service within all incorporated limits served by the Company except San Francisco, Oakland, Berkley, Piedmont, Emeryville, San Leandro and Albany.

Rate—

First 10 k.w. hrs, or less per meter per month $1.00 per month.
Next 40 k.w. hrs. per meter per month 6c. per k.w. hr.
Next 150 k.w. hrs. per meter per month 5c. per k.w. hr.
Next 800 k.w. hrs. per meter per month 4c. per k.w. hr.
Next 2000 k.w. hrs. per meter per month 3c. per k.w. hr.
All over 3000 k.w. hrs. per meter per month 2.5 c. per k.w. hr.

SCHEDULE L—3.

General Lighting Service—

Applicable to general domestic and commercial lighting service, including household appliances and single phase service to motor loads not to exceed 5 h.p. capacity.

Territory—

Applicable to service in entire territory served, outside incorporated limits.

Rate—

First 10 k.w. hrs. or less per meter per month $1.25 per month.
Next 40 k.w. hrs. per meter per month 7c. per k.w. hr.
Next 150 k.w. hrs. per meter per month 6c. per k.w. hr.
Next 800 k.w. hrs. per meter per month 5c. per k.w. hr.
Next 2000 k.w. hrs. per meter per month 4c. per k.w. hr.
All over 3000 k.w hrs. per meter per month 3.5 c. per k.w. hr.

Minimum Charge.

(a) Where lighting service is supplied from a power bank of transformers or from distribution lines of 5,000 volts or less, the minimum is $1.50 per consumer per month.

(b) Where a separate transformer is required to be installed on distribution lines in excess of 5,000 volts, the minimum charge will be $2.50 per month for one consumer and $1.25 per month per consumer for two or more consumers.

Special Conditions

Under all three schedules it is provided that single phase motors of a capacity of 5 h.p. or less may receive service or may be combined with general lighting service under the schedule of rates at the option of the consumer, provided in case of combination service the total energy is supplied through one meter. The minimum charge applicable to this combination service is the minimum charge as set forth in the schedule.

In the first schedule (L-1) it is provided that motors in excess of 5 h.p. may receive service or be combined with general lighting service under this schedule of rates at the option of the consumer, provided in case of combination service the total energy may be supplied through one meter, in which case the total minimum charge will be 90c. per h.p. per month of motor load. Combination will not be made between a-c. and d-c. service. Single phase and polyphase will not be combined unless obtainable from the same service wires. The Company has the option of refusing d-c. service where both a-c. and d-c. service are available.

Unfortunately the report does not show the rates for the other services. The details of operation show a system yearly load factor of over 60 per cent. indicating that electricity is also sold for industrial and irrigation purposes.

It is to be noted that variations are made in the rate schedules depending upon the population served in a district. Cities and towns all use the same rates excepting for the first 10 k.w. hours per month where the larger places receive a slight reduction and a corresponding lower minimum bill. The rates for suburban districts are slightly higher than those used within corporate limits, but are not intended to produce as high a rate of return. The order states that developing business and service in

developing territory should not be expected to return to the utility as great a net as business in more congested districts.

Location as to the points of generation is not considered. The whole area served by the Company is taken as a unit, and whether a town is close to or far away from its source of supply is not permitted to have any bearing on the case. So long as the system as a whole shows a satisfactory statement of operation that is all that is required. Such districts as would show an excess of earnings must necessarily provide funds to balance the deficits created in others.

Applying the rates as given for use in the larger cities to conditions obtained in Ontario, an average householder using electricity for lighting and the operation of small appliances would have an average rate of over 6.6 cents per kilowatt hour. If an electric range were used the average rate would not be less than 5.4 cents per kilowatt hour. One is given the impression that the rates are not conducive of extensive use of household electrical appliances and except for the more well to do families the use of electricity would be confined to very little more than lighting.

It would appear from the form in which the rates are quoted that a service charge is not used. Although it is not so stated, we may safely infer that the question of service charge has been given consideration and that provision has been made for it in the minimum monthly bills. The authors of the rates have no doubt considered the second consumption rate as applying to the first 50 k.w. hours per month and have added to the bill for the first 10 k.w. hours an amount for service charge, viz.: 30 cents per month in the larger municipalities; 40 cents per month in the smaller and 55 cents per month in the suburban districts. If our inference is correct, all lighting services in a district are considered to be of the same capacity and to create the same demand upon the distribution system.

The whole area served by the Company is considered in the light of one large municipality. Rates for service are dependent upon local conditions of service only without regard to the cost of that particular service.

* * *

Hamilton Hydro's New Office

ON April 3rd, at 5 p.m., Sir Adam Beck formally opened the new Hamilton Hydro shop and office building, 12 and 14 King St. East.

At noon the electrical manufacturers entertained the visitors at lunch and following the opening the Hamilton Hydro were the hosts at a dinner at the Royal Connaught Hotel. The speakers were Sir Adam Beck, Mayor T. W. Jutten, Commissioner Guy H. Long, W. K. Sandersen, and the Chairman, Willoughbly Ellis.

No finer building for the display of electricity in all its marvellous uses exists in Canada than the new Hamilton Hydro Shop. After months of work during which the whole structure has been remodelled and thoroughly modernized, and a large addition constructed in the rear, the contractors have completed their job and have turned over to the Hydro Commission a building which could not be excelled for the special uses to which it will be put.

The interior of the building is thoroughly in keeping with the imposing front. Large rotary doors give entrance to a spacious showroom extending the entire sixty feet width of the structure and about half its length of 137 feet. This showroom occupies two stories, a mezzanine floor skirting its circumference where the second floor would be ordinarily. Huge, white Ionic columns support the balconies, and the whole is finished in spotless white, with white Canadian marble floors. The impression is one of loftiness and chaste beauty.

Wrought iron stairways, in handsome designs, with marble steps, lead to the mezzanine.

Immediately in the rear of this sales section of the building are the tellers' cages, counters, and so on, which divide the sales portion or front of the building from the office section. Here will be paid the Hydro-Electric bills, etc., in future, and it is possibly in this feature that the public will appreciate the new Hydro building. Being on the ground floor and on a level with the street, this will be of the greatest convenience to the general public, with no stairs to ascend or descend to reach the offices.

At either side of the counter are beautiful marble staircases leading up to the second floor. On the second floor are located the general executive offices, including the offices of Chief Engineer E. I. Sifton, and Secretary W. H. Childs. Everything to the advantage of a business office has been included in the construction of this floor. The rear portion is lit by a huge skylight from above with a large light court in the centre. On the second floor, above the main showrooms are located the board room and other departmental offices.

Patrons of the Hydro-Electric store will not be merely shown the various appliances in which they are interested, but will see them installed and

Billing and Contract Office

Front portion of Show Room

Hamilton Hydro-Electric System Administration Building

Rear portion of Show Room Showing tellers' cages and General Office

actually in operation. On the mezzanine floor is located a model laundry, with tubs, washing machine, heating tank, ironer, etc. Next to it, separated by a moveable partition is a model kitchen, with up-to-date plumbing, electric refrigerator, dishwasher, range—everything that a housewife could desire in the way of equipment. A model diningroom, containing all electrical appliances needed, a bedroom, living room and den, complete the suite of ideal apartments.

A space has been set aside on the mezzanine facing the front entrance as a lounge, and from here the whole extent of showroom may be seen.

The third floor of the building has been merely renovated, and certain structural changes made. The rooms are vast in size, with lofty ceilings, floored with polished oak and mahogany which is a revelation in the woodworker's art. The woodwork is finished in white enamel, and the fireplace is of hand-carved white marble. A rich purple and brown paper covers the walls, giving the apartments, which include the commissioner's chambers and the board room, an almost palatial air.

One possession of which the commissioners are especially proud is the big solid mahogany table in the board room. The massive piece of furniture was constructed out of the mahogany fittings removed from the bank.

The remodelling of the basement has been carried out very thoroughly, and a large area of storerooms, washrooms, etc., has been provided. The walls have been refaced, concrete floors put in, and the whole rendered about as fine as a basement can well be.

The convenience of the employees of the department, as well as that of the public, has been studied in the plans for the building throughout.

Aspects of the Central Station Sales Effort

DURING the past few months the sales departments of the central - station industry have furnished a topic for many discussions. It seems to be generally believed that these departments should be more seriously considered, receive more attention and in many instances have the scope of their activities greatly broadened. If the men in such departments have not developed as rapidly as might be desired or the departments been as helpful as they should, the fault may not be entirely their own. In the stress of other problems sales departments have too often been permitted to drift of their own momentum and have not been used to the extent which might have been the case with proper organization training.

In some companies of our industry, even today, the sales department is organized merely to merchandise goods; in other cases it takes on some additional responsibilities for solicit-

ing small-power business; but in few instances does such a department really function in a broad way as a bureau of general business development and as a service department. Only in recent years has more been expected of a sales manager than to be the efficient head of a group of solicitors; but even though this be considered the sole purpose of such an organization, it is not certain that the industry has always reaped the full benefit of it.

The real mission of the sales department is to sell more electricity by both direct and indirect methods, and merchandising for profit cannot be considered as more than incidental. Probably for several years to come the long-debated question of whether a central station should deal in merchandise at all will continue to be a perennial cause for differences of opinion. It would seem that the answer may be found by considering another question, namely, "By selling merchandise can we render a needful or a desirable service to our customers which they cannot otherwise obtain?" If local dealers and contractors offer but an inadequate service, then most assuredly the central station should fill the gap, even though the transactions themselves may not net a direct and traceable profit.

If the dealer and contractor does this work as well or better than the central station, there does not appear to be much justification for it to remain in a business for which it is not organized and for which it is not prominently equipped. However, even in the latter case it is sometimes urged that central-station merchandising has a very salutary effect upon the methods and practices of other agencies engaged in the distribution of electrical goods.

It is at least generally conceded that the public utility does not desire a monopoly of the merchandising business, that the activities of dealers and contractors all redound to the direct and immediate benefit of the central station, and that the latter should encourage and stimulate the contractor and dealer as far as possible, always having in mind that the central station's most profitable obligation is its customer.

Those who are responsible for companies having established merchandising departments may well ask themselves: "Are all goods well sold?" Speaking very generally, the answer is "No," or at least not so well sold as they will be when volume ceases to be the goal of sales effort. There is room for much improvement in this respect. Stating the problem in other words, it would be: "Do our salesmen make people buy their goods rather than make them want to buy them?" and therein lies an important distinction.

Customer's closets and shelves contain many devices which they bought but did not want, and so they are out of use, producing neither revenue for the utility nor satisfaction for the owner. Some test inspections have shown as high as 25 per cent. of owned devices out of use largely because the keen desire for the service which the appliance could render was not sold with the device itself. In most instances, probably, this desire could have been implanted.

Doubtless more than 50 per cent. of the electrical devices in customers' homes are not used to anywhere near their possibilities. Sweeping a floor is only one of many uses to which a suction cleaner may be put; percolators will do more than make coffee; flatirons are capable of far more service than merely smoothing out damp cloth, and yet a discussion with a selected group of owners of such devices proves that they know little or nothing of their possibilities. It must be assumed that the salesman did not know them either, or that he was merely marketing an energy-consuming device and considered it no part of his duty to sell a service, his mission having ended with the making out of his sales slip.

In our calculations of the possibilities of load building we should not overlook the one of better selling. The dealer is interested in selling those devices yielding him the greatest profit. It chances that nearly all such are the most insignificant consumers of electricity, while, on the other hand, devices which are the best load builders cost so little in the first place that the retailer could give more than casual service. If we find upon investigation that those devices which have been poorly sold have been marketed by the dealer, we can at least consider the desirability of reselling them through advertising, service calls, etc. In any event our own sales departments must become something more than order takers and record writers if they are in any measure to justify their existence. It appears to be rather inconsistent with good business judgment to place so vital a factor as business development in the hands of the type of man who may be attracted by an inadequate salary and whose sole qualifications are those of a clever peddler.

Like the head of any operating department, the chief of the sales department should be a man capable of contributing real strength to the manager's staff. He should be familiar with the larger problems of public utility operation if he is to bring to his job that broad vision and understanding which now appear essential to successful operation. His position demands that he and his assistants maintain close contact with the public. It would seem to be desirable to select and train our sales managers to represent adequately their companies in that capacity. If they are to be bigger men, they will as a matter of course command larger salaries, but no public utility has yet conclusively determined the limiting value which can be placed upon the services of the right sort of men in this position, assuming that the latter means selling the company and its service to its customers rather than merely selling them energy-consuming devices.

Serious effort to train sales managers in many cases implies supporting them by furnishing better personnel in their departments. It has been too often assumed in the industry that if a given candidate for employment has no training, little education and appears good for nothing else, he should enter the sales organization. More careful selection of this sort of material could be exercised. It cannot be seriously maintained that our sales departments are today in general what

we would like to have them. A reasonable length of time, if accompanied by genuine effort, will make them more profitable and helpful adjuncts of the utilities and a constructive force in the community.

Having raised the standard of requirement and performance in our sales departments, we shall have therein organizations specially trained in an understanding of the consumer and his desires, his dissatisfactions and state of mind——certainly a factor of great potentiality in accomplishing our desire for improved public relations. That such departments are not generally used for things which they presumably can best do is simply another way of stating that they are susceptible to substantial improvement, without depreciating the excellent work which they have accomplished in their previous development.—*Electrical World.*

* * *

An Unusual Electrical Accident

Much has been done to reduce the number of avoidable accidents, yet we hear from time to time when such have taken place. The Electrical Review records one that could happen any time on our own systems, although warning and instructions for the avoidance of such are being continually impressed upon the men. In this case the unusual thing happened and the man lost his life. The report is as follows:—

"Mr. L. Birks, chief electrical engineer of the New Zealand Public Works Department, sends us particulars of an extraordinary fatal accident, which illustrates again how essential it is, in handling high pressures, to observe the safety precaptions in absolute detail. A 3,000 V. fuse had blown on an 11,000 V. pole transformer station at Te Aroha and the lineman and his mate went out to replace it. The transformer is supplied by means of a throw-over switch from either of two 11,000 V. circuits running across at the top of the pole station. The throw-over switch has a central dead position with a break of 9 in. from either set of jaws. The lineman unlocked the quadrant and opened the air-break switch, according to the evidence, to a distance of only about 4 in. instead of the full 9 in. break, and proceeded to climb from the platform to the 3,000 V. fuses making contact with the dead 11,000 V. leads. His mate beneath the platform then heard a discharge and the lineman fell dead on to the platform. On removal of the corpse, the dead body of a sparrow was found beneath it, quite warm and with the beak and legs burned off. When examined, the connections below the throw-over switch were all dead and safe and the deceased had not gone up within several feet of the live leads. Evidently the sparrow was killed simultaneously with the man and the accident was apparently due to the sparrow having made connection across the half-opened air-break switch, the momentary arc through the sparrow's body being sufficient to cause the death of the lineman."

The Life of Copper

The following extract from the Bulletin of the Copper and Brass Research Association leaves us with a question in our mind. Apparently the exposure of copper to the elements has but small result. In figuring the life of equipment, the destructibility of the copper in it need not be considered. In ordinary use the other elements entering into the construction give out leaving all of the original copper to be salvaged and eventually rebuilt into new equipment. When we consider transmission and distributing lines it would appear that provided they are of sufficient capacity and the supporting construction is maintained properly, the copper conductors would last indefinitely.

Some idea of how long copper has been used by man is afforded by the wonderful copper relics brought back from Egypt recently by Prof. Flinders Petrie, the great Egyptologist, as the result of work in the tombs near Abydos, one of the most ancient towns of upper Egypt.

The graves of Abydos were those of courtiers and royal servants of the first dynasty kings—and, some of the copper relics recovered are from a time almost unbelievably remote—from about 5,000-6,000 B.C.

Prof. Petrie was good enough, recently, to show these relics to a representative of this Association, who called on him at University College, London. The copper is in splendid condition, and consists for the most part of axe and adze heads, piercers, chisels, flaying knives, needles, pins, etc. Some of these copper needles, for instance, are just as fine as any in use to-day.

The copper articles are just as recovered, for the most part covered with the pleasing soft green tone of the old metal, but several of the larger axes still show in parts the original polish. One of these bears the name of King Zet, of the First Dynasty, and is therefore about 6,000 years old. This axe still retains the polish imparted to it by the King's coppersmith.

Professor Petrie has had these speciments drilled, and the drillings are now under analysis; the drill holes are clean and bright, just as one would expect to see a piece of high grade copper to-day.

Adjustment and Compensation of Electrical Instruments

By PERRY A. BORDEN,

Assistant Laboratory Engineer, H.E.P.C. of Ontario.

This is the second of a series of articles dealing with the use of Electrical measuring instruments. In the former article it was shown that there were many sources from which it was possible that errors might find their way into electrical measurements, whether performed in the field, the shop or the testing laboratory. Many precautions were discussed, which, if carried out, would tend to reduce the possible errors, particularly those arising from sources external to the instruments used, but little was said about the adjustments of the instruments themselves. In this paper a number of these internal errors will be treated, with particular reference to those classed as "Inherent Errors," and means described whereby these are reduced to negligible values or cancelled by opposing effects purposely introduced into the measuring system. It is not the intention to convey the idea that these adjustments are such as can be indiscriminately performed in the field but it is felt that a knowledge of the means by which the various adjustments and compensations are accomplished, will help the user to appreciate the fact that the accuracy of measuring instruments is not a matter of pure guesswork, and that satisfactory operation is obtained only by the adjustments being carried out in accordance with very definite laws.

THE principal adjustments which are required of every indicating and graphic instrument are the following:—

(a) Scale length.

(b) Scale proportionality.

(c) Zero.

(a) Scale Length.

In all indicating instruments, the position of the pointer or indicator is determined by the action of two forces: the measuring torque and the

opposing torque. The former is derived from the electrical quantity under measurement, and the latter from a spring or weight or other means so arranged as to oppose the measuring torque and increase its value as the indicator departs from the zero position. Upon application of torque in the measuring circuits of the instrument, the movement is deflected, carrying the pointer across the scale, and at the same time causing the spring or weight to develop a counter torque. This action continues until a condition of balance obtains, and these two torques are of equal value, at which time the position of the indicator is a representation of the value of the electrical quantity in the circuit being measured. In practically all portable instruments and in most switchboard instruments the counter torque is supplied by a spring, and the characteristics of this spring determine the amount by which the movement will deflect before a balance is obtained. The mechanical characteristics of springs are in themselves a study; and the strength of a spring is affected by its material, its temperature, its physical dimensions and its past history. All these properties are the subject of intensive study by instrument manufacturers, and much of the merit of an instrument lies in the amount of attention the builder has given to the subject of spring design. As placed upon the market, the spring represents the manufacturer's opinion of the best suited spring for the work in hand, and it is seldom advisable to attempt to make adjustment to an instrument by any change in any of the properties of the spring which have been mentioned above with the possible exception of length. Many builders of instruments provide an adjustment in spring length; and, as a long spring develops less torque for the same deflection than a short one otherwise the same, it follows that lengthening the spring will have the effect of lessening the counter torque and thus increasing the travel of the pointer for the same amount of deflecting force. Briefly, this may be stated, "Lengthening the spring expands the scale and shortening the spring contracts it."

In gravity controlled instruments, such as some types of graphic meters, the counter-torque is supplied by a weight, in which case it is necessary to adjust the magnitude of this, if adjustment by means of counter-torque is desired. If the whole mass of the counterweight is supported by the metering element, it will be required to change the value of the weight by taking away or adding material, as may be needed. If, on the other hand, the weight be supported from two points, one being in the metering element, it is usually possible to accomplish the desired adjustment by changing the position of the weight on the supporting arm.

Adjustment of scale length is sometimes performed in voltmeters, wattmeters, shunted ammeters or other instruments having resistances in series with the actuating windings, by changing the value of the resistance of the circuit. This usually requires the assistance of a soldering iron but is a positive way of accomplishing the adjustment and is capable of very

precise results. None of these adjustments of scale length should be attempted by any other method than the manufacturer intended should be employed.

(b) *Scale Proportionality.*

It is frequently observed that an instrument will be found reading high on one portion of the scale and low on others. The causes of this fault are somewhat diverse, and correction of the error must usually lie along the line of finding the original cause and rectifying it. The main causes are: bending or shifting of the pointer, distortion of the mechanism and disturbance of balance. To this must be added strains set up in the spring due to mishandling or overheating.

In most indicating instruments the pointer must bear a definite relation in position to the actuating part, whether it be a coil or an iron armature. If the pointer should become bent or should slip around on the shaft, it will be found that a simple correction of the zero will not suffice to bring the indications into even approximate agreement with the original scale. The only satisfactory way to rectify the error lies in correcting the mechanical displacement which may have taken place; or failing this, in marking a new scale. An effect similar to the above will be produced due to displacement or distortion of some parts of the measuring element. Any cause which will produce a change in the shape of the magnetic field or of the moving part or in the relative position of the two is almost sure to introduce proportionality errors, and the correction, as above, lies either in rectifying the mechanical fault or providing a new scale.

In the construction of high grade spring controlled instruments, an effort is usually made to have the moving part in a state of neutral equilibrium as regards gravity balance, but as this necessitates very tedious adjustment, the condition is seldom exactly obtained. As a consequence, errors of greater or less magnitude are likely to make their appearance when the instrument is tilted into another position from that in which it was originally calibrated. In the instance of switchboard instruments which are usually checked in the same position as they are finally installed, little trouble may be expected from that source; but with portable instruments it is well to exercise care that they are kept reasonably level when in use, and an instrument intended for use with its shaft in a vertical position should not be used with it horizontal, or vice versa, until the user has assured himself that the errors so introduced will not be of prohibitive magnitude. A check of the balance may easily be made by placing the instrument in a number of extreme positions and observing the zero shift. In instruments having partial or complete gravity control, it is imperative that the device always be levelled with care and maintained in the one position.

Owing to the very noticeable proportionality errors which may be introduced into the accuracy of instruments due to a very small change in the physical relation of the parts, it is customary in all but the very lowest grades to mark the individual

scales for the meters after construction and not to rely upon scales printed or otherwise copied from an original. Thus, the scales of instruments of the one type and rating will differ slightly in individual instruments, and will not be interchangeable. For the same reason, if repairs or alterations necessitating structural changes in an instrument have been made, it will frequently be found that the calibration of the altered meter will not check with the original scale. In such cases it is sometimes possible to bring the accuracy back to the original proportionality by altering the position of the pointer relative to the actuating mechanism, but it is usually found necessary to mark an entirely new scale.

(c) Zero.

If accurate results or duplications of the original performance are desired from a measuring instrument, it is manifestly necessary that the zero point of the scale be maintained. This is a precaution that is frequently overlooked, and which may be responsible for very erratic results in reading. The zero furnishes us with a point of reference upon which all other measurements are based; and if it is in error, it is evident that little reliance can be placed in the indications of the instrument as obtained at other points of the scale. The causes of zero displacements have been fully discussed under various heads in the previous article dealing with sources of error. Strains in the spring material, temperature effects and disturbances of balance may be responsible for these displacements. And in general it may be said that whenever the moving part of the instrument has sustained damage of any kind, it is sure to be reflected in an abnormal shift of the zero. Even the highest grades of spring-controlled instruments are subject to zero errors and before making use of their indications the pointer should be brought to the proper setting. The spring which controls the deflection of the moving element of an instrument is generally carried on the end of an arm adjustable about the centre of rotation of the pointer, and this adjustment, by varying the position of the fixed end of the spring, is capable of moving the pointer through a small angle in either direction, so that it may be brought to the correct zero position before readings are taken. In practically all modern high grade instruments an adjustment is provided outside the case, so that the zero may be corrected at any time without disturbing the delicate parts of the instrument.

Where gravity is the controlling force, zero adjustment is usually accomplished by shifting a weight normally fixed to the moving element, so that this part will take up a new position of equilibrium when the load is removed. If the zero error in any type of instrument is found to be beyond the range of the adjustment provided, or if a sudden change of considerable magnitude is observed, one may be assured that there is something seriously wrong with the meter and that its indications should not be made use of, until a repair has been effected.

Compensation

The term "compensation," as here used, covers the several methods which are available for minimizing or eliminating the errors which may be introduced into the indications of one instrument by the presence of another in the same circuit. The most common of these occur where measurements involving current and potential difference are simultaneously made. As mentioned in the previous article, it is not a safe practice to connect an instrument in while its reading is being observed and then disconnect it while reading another. The change in connections may introduce a disturbing element, productive of considerable errors, particularly where measurements are being made upon small amounts of power. As a typical example of this condition, may be mentioned the problem of measuring the power consumed by a small highly inductive load, such as a fractional horsepower motor running light, at a definite value of voltage. On first thought the arrangement shown in Figure 1 would suggest itself as one which would give correct results, the line voltage being applied to the voltage circuit of the wattmeter and the voltmeter, while the current consumed by the motor passes through the wattmeter. It so happens, however, the wattmeters of the low range which would be necessary for a test of this type are very likely to have a current coil of an inherently high resistance, which would introduce into the circuit a voltage drop on the current passing, so that the voltage at the terminals of the device under test will have a considerably lower value than on the line. The result of this is that the readings of the voltage and wattage will be considerably higher than the actual quantities in the motor under test. If an attempt is made to rectify this condition by connecting as in Figure 2, the voltage circuits of the instruments being fed directly from the

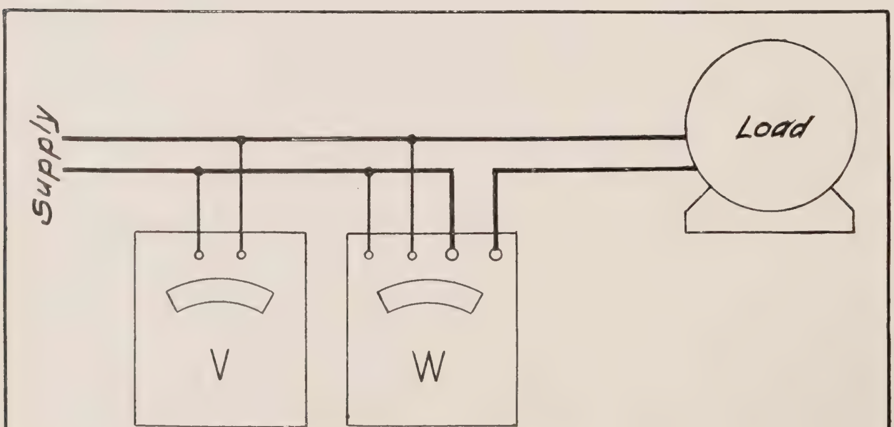

Fig. 1

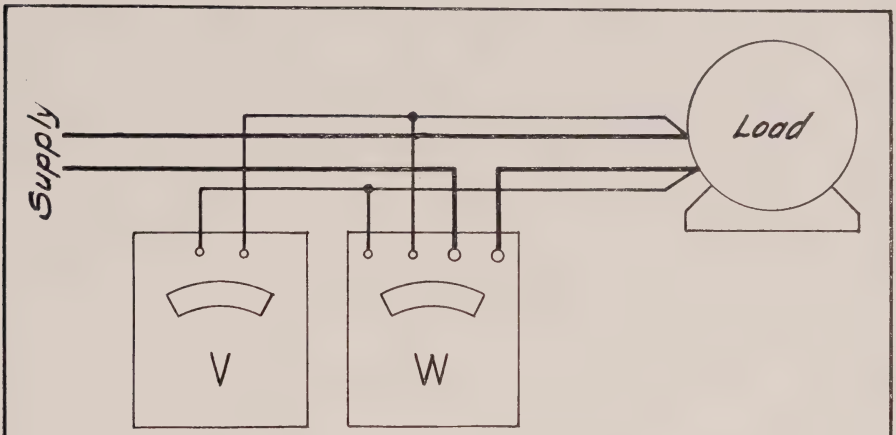

Fig. 2

terminals of the circuit under test, a new difficulty is met, in that the power consumed by the voltage circuits is now included in the registration of the wattmeter. This, however, may be corrected for: if these be non-inductive instruments, the watts consumed may be calculated from the resistances of the voltage coils, and in any case, the power consumptions may be easily measured. Probably the simplest method of accomplishing this compensation lies in taking two readings, one with the load off, giving the instrument consumption alone, and one with the load on, giving a total, the voltage being adjusted to the same value in each test. The difference of these readings will represent the watts consumed in the load. In the accurate measurement of amperes on small loads it is more difficult to make compensation; and, if precise results are desired on very small loads, it is usually necessary to resort to some null method suited only to laboratory equipment.

In certain ranges, wattmeters are available having a "compensating coil" which automatically performs this correction by causing the current consumed by the voltage circuit to flow around the current coil in a separate winding, this neutralizing the effect it produced as it first passed through the instrument. Where instrument transformers are used in the circuit, the errors due to power consumption in the instrument are usually reduced to a negligible value, so that compensation for these losses is made unnecessary. As previously stated, the power consumption of a good instrument is seldom over 10 watts, so from this the user may decide for himself whether or not a compensation is necessary.

HYDRO NEWS ITEMS

Central Ontario System

Plans are being prepared and tenders for equipment are being submitted for development at Dams 8 and 9 on the Trent Canal System. The total rating of the two plants will be approximately 10,000 horsepower.

* * *

The National Castings, Ltd., Belleville, are operating a 200 k.w. electric furnace, turning out a high grade of cast iron and cast steel. The furnace operates at a power factor of 90.8%.

* * *

The Oshawa Railway Co. has purchased a new electric locomotive for freight handling service.

* * *

A contract for service has been submitted to the Police Village of Warkworth. It is proposed to build a step down station on line "R" and supply Warkworth at 2,200 volts single phase.

* * *

Niagara System

The Niagara Falls Hydro-Electric System recently put into service their new sub-station. The location of the new building is nearer to the centre of load for the System, and accommodation for the local offices has been provided for.

* * *

Arrangements have recently been made for additional Hydro debentures for the municipalities of Ford City, Riverside and Tecumseh. Under present arrangement, these municipalities receive their power supply from the Walkerville sub-station, and the systems are operated for the municipalities by Walkerville.

* * *

Arrangements have recently been made whereby York Township Hydro-Electric System is to purchase from the Toronto Hydro-Electric System that part of the distribution system formerly belonging to the Toronto & Niagara Power Company and located in York Township. This system will be incorporated with the present Hydro system, and the rates to former Toronto & Niagara Power Company customers have been made the same as York Township Hydro-Electric System customers, commencing March 1st.

* * *

St. Catharines Public Utilities Commission recently purchased 3 500 kv-a single-phase transformers for use at their proposed new outdoor type sub-station.

* * *

It is expected that a rural line will be constructed from the limits of the City of Sarnia as far south as Corunna during the coming summer, and it is also expected that arrange-

ments will be made to extend a line from Wallaceburg to supply customers at Port Lambton and Sombra. As soon as weather conditions will permit, a rural line will be constructed from Blenheim to supply customers at Cedar Springs and Erie Beach. The total length of this line will be approximately ten miles.

* * *

Rideau System

Ample water is now obtainable at High Falls and the shortage of power on the Rideau System is at an end. A considerable increase in load is expected during the month of April.

* * *

The suit brought by the Kemptville Milling Co. against the Town of Kemptville was heard at the Assizes in Perth, on April 9th, before Mr. Justice Rose. Both parties produced a large number of witnesses and the trial lasted for three days. Judgment was reserved.

* * *

The Village of Lanark, with a population of about 500 people and 111 consumers, completes the year 1922 with a surplus of $1,185.06.

* * *

Association of Municipal Electrical Utilities

Minutes of Meeting of Executive Committee April 13th, 1923

The meeting was called to order at 2 p.m. at the office of the Hydro-Electric Power Commission of Ontario, Toronto, by the President, Mr. A. T. Hicks. Other executive officers present were:—Messrs. J. E. B. Phelps, J. J. Heeg, W. E. Reesor, P. B. Yates, G. J. Mickler, V. S. McIntyre, J. R. McLinden, M. J. McHenry and S. R. A. Clement.

It was moved by Mr. W. E. Reesor and seconded by Mr. J. E. B. Phelps:—That the minutes of the last Executive Committee meeting be taken as read and adopted.

CARRIED.

This meeting was for the purpose of receiving reports from the various committees regarding the summer convention to be held at Orillia.

Mr. W. E. Reesor, Chairman of the Convention Committee introduced Mr. F. Gover, Secretary, Water, Light and Power Commission, Orillia, who reported as to the plans for the Convention. It was proposed that the Convention be held on June 20th, 21st and 22nd, 1923, at the Orchard Park Inn, and the program laid out as follows:—

Wednesday, June 20th: Registration in the morning, a convention session in the afternoon beginning at 2 o'clock, and convention dinner in the evening.

Thursday, June 21st: The Association will be the guests of the Orillia Light, Heat and Power Commission on a boat trip down Lake Couchiching and the Severn River as far as the Swift Rapids Power Plant and Return. In the evening a dance will be held.

Friday, June 22nd: In the morning beginning at 9.30 and afternoon beginning at 2 o'clock, there will be convention sessions. At 4.30 that afternoon there will be a baseball game.

Entertainment will be provided for the ladies during the convention and if desired, tents will be provided for an exhibit by the manufacturers.

The Convention Committee was instructed to proceed with preparations along the lines outlined in the foregoing and obtain a speaker for the Convention Dinner.

The Secretary was instructed to enquire of the Commercial members whether it is their desire to hold an exhibit at the Convention.

Mr. M. J. Henry, Chairman of the Papers Committee outlined suggestions for papers and discussions for the convention. It was moved by Mr. V. S. McIntyre and seconded by Mr. J. R. McLinden: That the following papers and discussions be given:—

Wednesday, June 20th, Afternoon, business session to be followed by a report by the Merchandising Committee and a general discussion on merchandising.

Friday, June 22nd, Morning, a paper by Mr. C. Baker, Packard Electric Co. on Transformer Design, giving particular reference to exciting currrent and the question of using 2,400 or 2,200 volts as the standard voltage, to be followed by discussion.

Afternoon, a paper by Mr. A. G. Lang, Distribution Engineer, H.E.P.-C. of Ontario, on Underground Distribution, to be followed by discussion.

CARRIED.

The Secretary was instructed to obtain convention badges after the form previously supplied. He was also instructed to write the Hydro-Electric Power Commission of Ontario, extending an invitation for the superintendents of the various systems in the Georgian Bay District to attend the convention.

The District Directors were advised of the utilities in their several districts that were in arrears for dues. They were instructed to communicate with those various utilities with the object of having them continue their membership.

On being regularly moved and seconded the meeting adjourned at 3.45 p.m.

Note:—Owing to the convention of the Canadian Electrical Association being scheduled to be held on June 20, 21, and 22, the dates given in the foregoing minutes have been changed to June 13, 14 and 15.

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MAY, 1923

Hydro and the Consumer

Having just completed a brief description of the formation and development of the Hydro-Electric Power Commission of Ontario, we are fortunate to receive a report of a study of its workings as prepared by one on the outside. Mr. Judson King, Director, National Popular Government League, Washington, D.C., gives the story of his personal investigations. Mr. King's report was prepared primarily for circulation in the United States, and, therefore, contains certain criticisms and recommendations regarding the operation of electric utilities in that country. As the report is a lengthy one, we are using only those portions in which he describes his findings in Ontario.

Mr. King shows the great number of uses to which electricity can and is being put in Ontario with a very low cost of operation for the user. The saving in time and labor for the housewife eclipses the expense even for those of moderate means. But this brings up another detail of electric utility operation that must not be overlooked. The various appliances and labor saving devices must be kept in working condition. It is only by so doing that the maximum benefit will extend to all concerned, more especially the consumer and the utility.

Human Nature, Efficiency and Electricity. The Strange Story of Ontario.

By JUDSON KING,

Director, National Popular Government League, Washington, D. C.

A BRIGHT young business man put this one to me. "If you owned $1,000 worth of stock in an electric light company which paid last year, say, seven per cent., would you cash a $70 cheque as your share of the profits?"

I said that I would.

"And if you were an 'insider' with $1,000,000 invested and a 'melon' was cut, would you accept, say, $500,000 as your slice?"

I said that I would; it would come in handy.

"I thought so, and am glad you are honest enough to admit it."

"What's the big deduction?"

"Simply that people who howl about the extortions and rascalities of public service corporations are no better than the folks who run them. The critics would do the same thing if they had a chance. It is human nature."

"Will the gentleman yield?" I asked after the fashion of a Senator in floor debate. My friend yielded.

"You have an eight-room house and you use electric lights. What does it cost you? What's the rate?"

"Umm-mm--I don't know the rate, but it was around $45 for last year. My wife keeps accounts."

"Got an electric range—washing machine—etc.?"

"No! What do you think I am? Millionaire?"

"But if your wife had a range, a washing machine, electric irons, hot water tank, percolator, vacuum sweeper, toaster, fans and 35 Mazda lamps all over the house—in short an equipment enabling her to do her work in one half the time and with one third the labor—and could buy the electricity to run *the whole thing* for $45 a year, *would you patronize such a system?*"

"Of course. But there ain't no such place. It's ridiculous. Why ask?"

"Oh, merely testing out human nature," I replied.

These Canadian business men have put one over on us. They originated and have in successful operation absolutely the biggest electric light and power plant in the whole world. It is located in the Province of Ontario right across the Niagara River. Its glory is dimmed somewhat by the fact that it is monopolistic, and we are opposed to monopolies. Nevertheless there it is—as a sheer engineering proposition, the greatest ever. Is the United States to be

outstripped in efficient application of hydro-electric energy to progress and human welfare?

It is a phenomenon well worth an inquiry. The development of electric power from water power has become an industry of the first magnitude in the United States. We are proud of it. The National Electric Light Association has an advertisement in the Saturday Evening Post of March 31st., which states that "FIVE BILLION DOLLARS are now invested in this business"; that the "energy output has been quadrupled in ten years. . . . *due to the courage and vision of the men who have developed these public service enterprises* . . . the builders of giant electrical machines and far flung transmission lines."

That's great. Why then the claim that these Ontario people best us not only in giant equipment but in more efficient management of their equipment. I spent a week in Ontario last summer to find out if it were true. Sure enough, there at Queenston is the largest power plant, equipped with the most gigantic generators; the largest canal of its kind which takes water from above Niagara Falls and pours it through the mammoth turbines eleven miles below. There were "far flung wires" galore running to Toronto, to Windsor, opposite Detroit, and to hundreds of cities, towns, hamlets, farm districts, and manufacturing plants all the way between. In addition there are 13 smaller generating plants, scattered, all under the same management. No duplication. No waste. In Ontario they call the system "HYDRO" for short. I shall use the abbreviation.

It is one of those "Can't-be-done, but-here-it-is" experiments. A vast dream come true and of great credit—we must admit—to the "courage and vision" as the Post advertisement says, of the promoters, engineers, and financiers who put it over.

Now I have peculiar ideas about investigation. So when Engineer J. R. Montague started out to show me the canal and the plant, I respectfully requested him to take me to a home using their juice—I wanted to talk first with an ultimate consumer. He willingly, almost eagerly complied and drove me to the home of Jack Cullom, in the little city of Niagara Falls, in Ontario, of course, not New York.

Mrs. Cullom was at home. She showed me her electric range on which she did all her cooking. I noted a fan on top of the range; also her washing machine, her electric irons; her vacuum cleaner; percolator; toaster; a splendid hot water tank for all household purposes; an electric bed pad useful in sickness; and some 35 large Mazda lamps which lighted her eight room house.

On request she showed me her July bill. I have it now. She had used 334 kilowatt hours. It cost her $3.55. She keeps accounts. Her *yearly* bills run about $45.

She explained that she used all the current she wanted without

worry, that her equipment enabled her to do her work in ONE HALF THE TIME AND WITH ONE THIRD THE EFFORT that it formerly took.

She is a handsome woman, fresh, vigorous, evidently not overworked. The house was immaculate, and I asked her if she kept a hired girl. She contemptuously replied, "I do not. A woman with my electric equipment who needs a hired girl I think is lazy." Also she praised Hydro and its good service which enabled her—the wife of a mechanic—to have such blessings. Another touch of human nature!

So much service for $45 a year seems to indicate efficiency on the part of Canadian engineers and managers. I must reluctantly confess that they are more efficient than any American company I have yet discovered.

For example, by way of comparison: Mrs. Cullom's July bill for 334 kilowatt hours was $3.55. By a remarkable coincidence my wife's electric bill for last December showed exactly 334 kilowatts—but the cost was $23.18.

Since here in Washington, D.C., we have an able Public Utilities Commission appointed by the President whose duty it is to regulate the rates and service of the Potomac Electric Light and Power Company—we call it PEPCO for short—I am reluctantly forced to believe that a greater degree of efficiency is needed and that men of wider vision and courage should be given a chance. When I showed my wife Mrs. Cullom's bill of $3.55 as against her bill of $23.18 for the same number of kilowatts, her human nature expressed itself. I consoled her somewhat by telling her that if we lived in *New York, Massachusetts, or almost anywhere in the United States*, the bill would have been about the same as in Washington.

Coming back to Ontario, I could not then see why Canadians should have more individual initiative than Americans. Something was wrong somewhere. I questioned Mr. Montague sharply, but he denied there was anything exceptional about the Niagara Falls rate, even though it was close to the plant.

He referred me to the Annual Report of the Hydro system for 1921, which later I got and studied. It is a large volume of 550 pages illustrated, and must have cost a good deal of money, as it is well printed and widely distributed. In this respect our American managers are more wisely economical. Yet the Report did give me the facts I wanted even to minute details on every city, or "unit", and on the system as a whole. I have not seen its accuracy disputed. From it I learned that prior to HYDRO, electric rates in Ontario were about the same as in the United States at present—that is, averaging around 10c. per kilowatt hour for domestic service. But since the establishment of HYDRO in 1910 rates have been constantly dropping. It appears that the net cost to home consumers for 1921 was:—

in 9 municipalities less than 2c. per kilowatt hour

in 13 municipalities less than 3c. per kilowatt hour

in 23 municipalities less than 4c. per kilowatt hour

in 20 municipalities less than 5c. per kilowatt hour

This includes all the sizable cities in the province. Those longest in the system usually have the lowest rate. Toronto was 2.2c. per kw-hr.; St. Catharines, 1.4c.; Windsor (252 line miles from the Queenston plant), 3c.; London (100 miles away) 1.9c.

Prior to the establishment of the HYDRO system in 1910, rates in Ontario were about the same as rates in the United States now. This is around 10c. per kilowatt hour for house users. Since then they have been decreasing. I am loath to burden this bulletin with "statistics" and figures. They are hateful things, especially on monthly bills. I shall risk your displeasure, however, by reproducing from page 446 the following table from the London "unit" which is, please note, exclusive of the current used by the commercial and manufacturing interests, but which shows similar reductions.

You will notice that these efficient Hydro managers were selling to 10,000 more homes in 1921 than in 1912; that their enterprise increased their total receipts from $28,000 to $185,000; that each average housewife is using nearly four times as much current, which means there are many, many Mrs. Culloms in London.

Through forty pages of this amazing report, I found similar results in PRACTICALLY ALL THE CITIES OF ONTARIO. Very small towns, or hamlets, or farm

COMPARATIVE TABLE—CITY OF LONDON, ONT. 1912-1921

Domestic Consumption of Light and Power.

Year	Total Revenue $ c.	Total Kw-hr. Used	Number of Home Customers	Average Kw-hr. Used Monthly	Average Monthly Bill $ c.	Net Cost Per Kw-hr. c.
1912	28,196.62	....	3,851	....	....	....
1913	41,932.42	920,000	5,201	17	.77	4.5
1914	57,473.08	1,192,000	6,299	18	.83	4.8
1915	57,184.75	1,732,435	7,326	21	.70	3.3
1916	71,146.90	2,378,144	8,282	25	.76	2.9
1917	86,454.36	3,288,286	9,036	31	.83	2.6
1918	99,240.58	3,855,134	10,703	32	.83	2.5
1919	118,188.27	4,885,144	11,495	28	.86	2.4
1920	143,963.71	6,609,361	12,386	44	.97	2.2
1921	185,949.18	9,492,585	13,117	60	1.18	1.9

Note: Prior to HYDRO, the people paid NINE CENTS per Kw-hr.

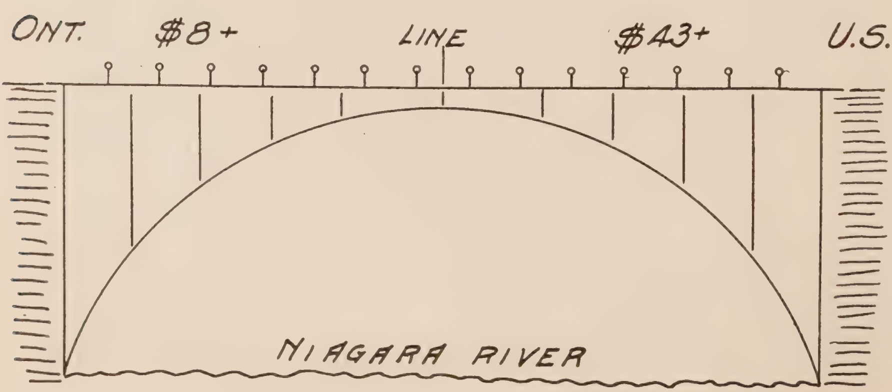
units with less than 100 consumers had rates from 5 to 10c. per kw-hr., varying according to conditions.

The most interesting and startling thing to me about this report, which I confirmed by personal interviews with scores of people using HYDRO, is the fact that right through the war and since electric rates have been dropping, dropping, dropping in Ontario. Column 7 of the above table shows exactly how.

But let us get back to Engineer Montague. As we started out to see the great Chippewa Canal and went around the famous Falls, we passed the International Railway Bridge over the Niagara River. The cost of lighting this bridge is another interesting study in efficiency. The west, or Canadian side, is lighted by the Hydro people; the east, or American half by a New York company. Both use electricity generated by the river—same number of lights, same service. The average monthly cost of 1921 for lighting the bridge was as follows:—

Leaving Niagara Falls, I spent a week in Toronto and other portions of Ontario, keeping hot on the trail of the ultimate consumer. Next to the women I found the business men — the "commercial" users — most enthusiastic in praise of the "go-get-'em" tactics of the Hydro managers. In stores big and little, in doctors' and dentists' offices, in little towns and big cities, they chortled about "fine service" and "cheap rates." Over and over I heard the words, "*We are paying from one-fourth to one-third what we used to pay.*" When I grew skeptical and asked for proof, they got mad (some of them) and produced their paid bills.

For example, here is the bill of Appleton & Co., dry goods men, in the little City of Galt, out near the center of the province. In the month of July last they used 412. kw-hr., and it cost them $7.82. When I reached California, which Secretary Hoover praises as having the cheapest power anywhere, I set experts to work and found that in a town of similar size, San



Jose, Mr. Appleton would have paid $25.44 for this service. In Alhambra it would have cost $28. In Washington, D.C., $27.33. And still more in New York and New England.

The business men were puzzled and astonished that the reductions came along without any notice, fuss, or feathers. They frequently said that if rates kept on going down, they did not know where it would end. But how they did appreciate the vision, capacity, shrewdness, and business ability of those Hydro managers. The cheap rate was helping their towns, boosting business, keeping down taxes and what not.

This Town of Galt—population 13,000—has several small factories which save money. The City fathers save money on the city bills for lighting, etc. In fact, I had it figured up by an expert, and it appears that all of the consumers in Galt have saved in the last seven years some $3,089,962 by reason of the courage and vision of the Hydro people. But it was nettling to a patriotic American when they *sympathized* with me over what I had to pay in Washington.

These enterprising managers have even promoted their business among farmers. 8,000 farmers now light their homes and their barns, milk cows, pump water, saw wood, thresh, and their women wash, iron, bake, sweep, and all that just like rich city folks. It varies of course, but 20 per cent. do their cooking. Also many are putting in bath and toilet rooms. Most of them pay around 4 to 6 cents per kw-hr., which is half what American city folks pay. A special engineer is in charge of the "extension work" among farmers, and is making it pay.

The Labor Temple at Toronto is on the commercial schedule. The Secretary showed me bills for lighting the temple which told the same story as the others. For example this:

Feb. to June, 1911 (before HYDRO) 5 months, total $467.91
Feb. to June, 1922 (under HYDRO) 5 months, total $179.94

They commented on the fact that working men were rapidly putting electricity in their homes, cooking and all, and that the enterprising business like promoters of HYDRO in their city were installing a cooking range at reduced prices and letting them pay on the installment plan.

I have a copy of the hearings before the Senate Committee on the Fordney-McCumber Tariff Bill. In it is a memorial from the Chamber of Commerce of Niagara Falls, New York, asserting that Ontario manufacturing interests enjoy a power rate ONE-HALF that charged American companies on the New York side. They pray that the tariff rates be raised, or else the HYDRO methods be imported into the United States as they cannot stand the competition. Individual manufacturers testify as to $12 per horse power charged in Ontario, and $24 per horse power charged in New York, all power coming from the Niagara River.

They too asked a high tariff.

Service to the public and development of our resources are among the great aims of our masterful electrical promoters. They spend millions in magazine and newspaper articles advertising to educate and inspire us.

Public service is likewise the strenuous aim of the National Electric Light Association. Its object, as stated in its constitution is to "advance the art and science of the production, distribution, and USE of electrical energy for light, heat, and power purposes for PUBLIC SERVICE."

Yet and still the Canadians in Ontario are serving a larger proportion of their public than we are of ours.

To attract home seekers to any city think of the pulling power of an "ad." *such as Toronto can use today*, like this:

Such an "ad." appeals to human nature—especially to human nature in the United States. A page of it in the Saturday Evening Post would startle the country, get a million women talking, and immigration would set toward such a city.

The Canadians are doing it. The Hamilton, Ontario *Spectator* on September last issued an enormous special edition cracking up "HYDRO" and carrying "ads." from cities and towns over eastern Ontario boasting about low "power rates" to trap manufacturers; cheap "domestic" and "commercial" rates to lure business men and home seekers. They brag about "dependability" of service; that rates are not "jumped". And they make good. Distressing, but true. Ontario is growing in population and manufacturing. Hydro bonds are top-notch on the New York Stock

BUY A HOME IN TORONTO

Do Your Housework With Electricity

One Cent

WILL RUN AN ELECTRIC

IRON	1 HOUR
WASHING MACHINE	2 HOURS
VACUUM SWEEPER	3 HOURS

Cooking Rate: nine-tenths of 1c per Kw-hr.
House Lighting: 2.2c per Kw-hr.

RATES ARE GOING DOWN EVERY YEAR

COME TO TORONTO, CITY OF EFFICIENCY

Exchange. Business men, big and little, are solidly back of the system. The promoters who had the vision and courage to start it are popular captains of industry, needing no detectives to guard them.

But, mind you, this wonderful success is not due to NIAGARA FALLS. Long before the present HYDRO managers took hold, electrical companies used the river for generating power and sold it all over eastern Ontario. But their rates were high. Hamilton had an 8c. rate. Steam driven or water driven individual plants charged 9c. in London, 12c. in Waterloo, 15c. in Winchester, and 12c. in Windsor, exactly as the cities of New York State, some of them using Niagara power for the American side, are paying on an average of 12c., and the cities of Massachusetts an average of 14c. per kw-hr. So it is not Niagara Falls—though that helps some—but a Giant Power System plus a New Business Concept that accounts for HYDRO supremacy.

In a few American cities an efficiency approaching Ontario has been approximated. One steam driven plant in Cleveland, Ohio, has a 3c. rate for domestic, and another one a 5c. rate in the same city. Also in Los Angeles a plant driven by water brought 250 miles has a 5c. rate, with reductions promised soon. There are a few others.

In the midst of writing this bulletin, an advertising man came in and looked over the copy. "All rot," he exclaimed. "There is some trick somewhere—it's not possible—anyhow it can't last. Bet you a hat they'll have to raise rates! What are they NOW? Tell me that!"

It struck me my readers might take the same view, so I wired. The answer came yesterday.

"Audit Of Accounts For 1922 Not Yet Completed. Preliminary Information By Responsible Officials Shows Following Domestic Lighting Rates Per Kw-hr."

(Note: For convenient comparison, 1921 rates are inserted).

	1922 Rate From Telegram	1921 Rate From Report	Population
Toronto	2.08c.	2.2c.	512,812
London	1.82c.	1.9c.	59,281
Hamilton	1.88c.	2.1c.	114,766
Niagara Falls	1.53c.	1.6c.	14,805
Windsor	2.7c.	3.0c.	37,170

The telegram concludes: "These Rates Are The Lowest Ever Attained In These Municipalities. There Is No Apparent Reason To Suppose That The Rates Will Not Be Equal Or Lower For 1923."

This brings us up to date. There is no prospect of failure. The Ontario Giant Power System seems as solid as Gibraltar. What is more, these power magnates are tremendously increasing their business even among farmers. A letter from Chief Engineer Gaby, dated March 10, 1923, sent me by an American engineer, has some startling statements which coincide, however, with what I observed with my own eyes last July.

It states since 1921 over 6,000 new contracts have been made with farmers; that a "comprehensive plan for farm service" has been worked out, and that "in a very short time the farming community as a whole will enjoy the benefits of electric light and power." Rate sheets are furnished, and I note that a farm "unit" at Saltfleet, 53 miles from the "source of power" using a very large load has a 4c. per kw-hr. rate for house lighting and 2c. for pumping, sawing, threshing, etc. Also that some farmers with a "small load" 211 miles away at Ridgetown pay 7c. and 3c. respectively, which is not so cheap as Ontario cities, but almost half what American city folks pay. In Ontario each "unit", whether farm, hamlet, town or city has to pay on a basis of the cost of furnishing current to that place.

There are other points in Mr. Gaby's letter which should be called to the attention of organizations concerned with "the uplift of farm life" and with the "rural problem". Whether their by-laws and constitutions would permit extensive inquiry in this direction, I am not sure, but individuals at least might carefully consider the following: Says this engineer:

"Prior to 1910 farmers did not consider seriously the question of electrical power. They had plenty of help. Their wives and children did not demand the higher living conditions that prevail at the present time; the service was practically impossible to get, and the cost prohibitive.

"But the conditions changed . . . until the farmers found themselves with a scarcity of farm labor and are now looking about for labor saving devices. The women have been granted the franchise, and they now demand better living conditions."

The courage and vision with which the HYDRO people covered this new potential market has been roughly stated. But no statistics or cold reports can possibly tell the human side of the story—the human nature element, so to say. To get *that* you must visit the farm home of Ontario as I did last summer and talk with the women as well as the men. Even then you need a good imagination to visualize and get the significance of what is happening. You must listen to a busy farm wife with a house, a husband, a hired man, and three children to care for, who has no hired girl, and a mortgage on the farm. If she is not robust or in good health, interest deepens.

Let the wife of Eph. Kinzie, near Preston, a little woman with five children, tell you what a cooking

range means to her. No wood, no coal to lug. No ashes to carry out. Quick, clean, always ready. "Hired girl? No, can't afford one. Hard to get anyhow." And the electric washing machine "does help so" because she is not strong—105 pounds I should guess—yet with these helps she is able to keep her health and care for the children.

Or let Mrs. Hoffman, near Waterloo tell you how an electrically lighted farm house brightens life and helps to keep the boys and girls at home on the farm. Also the electric pump fills the big tank at the top of the house, and there is no hard long pumping, especially on Monday. That "wash day" has lost its terrors. Start the machine before breakfast and the clothes are on the line before ten o'clock. "Ironing day" also is a snap compared with the old method. Farm women and girls enjoy the bathrooms, I also found. Also there is less work when HYDRO saves the presence of an extra hired man or two on the farm.

The short of it is that with CHEAP ELECTRIC RATES the farm women of Ontario are beginning to have a real chance at the "fuller life" lecturers and magazines writers have pictured to them. But I must leave to the professors of social science the further development of this theme. Yet here again the Canadians have bested us.

President Theodore Roosevelt in the letter appointing his famous "Commission on Country Life" in 1910, said: (page 44).

"It is especially important that whatever will serve to prepare country children for life on the farm, and whatever will brighten home life in the country and make it richer and more attractive for the mothers, wives and daughters of farmers should be done promptly, thoroughly and gladly. There is no more important person, measured in influence upon the life of the nation, than the farmer's wife, no more important home than the country home, and it is of national importance to do the best we can for both."

Power Output in 1922

IN its number of April 7th., 1923, the Electrical World publishes statistics of the use of electricity on this continent from companies having an output in excess of 100,000,000 kw-hr. during 1922. The report covers ninety-two electric light and power systems and ten electric railway systems. The total output of these electric light and power companies during the past year was in excess of 41,436,000,000 kw-hr. Of this amount over 5,859,000,000 kw-hr. came from five Canadian systems.

The Hydro-Electric Power Commission of Ontario reported the largest output in kilowatt hours of

all systems in the world. Second in the list is the Niagara Falls Power Company, while the Commonwealth Edison Company of Chicago is third. The greatest peak load reported for the year was that of the Commonwealth Edison Company. The New York Edison & United Electric & Power Company had the second greatest demand and the Hydro-Electric Power Commission of Ontario had the third place.

The following tabulation shows the peak load in kilowatts, the kilowatt-hours output and the yearly load factor of the five Canadian Systems reported and also of the five largest systems of the United States.

System	Peak Load (kw)	Output for year (kw—hr.)	Yearly load factor per cent.
CANADA			
Hydro-Electric Power Commission of Ontario	460,471	2,392,092,267	59.3
Schawanigan Water & Power Co.	250,000	1,383,390,773	63.2
Ontario Power Co.	213,100	994,000,000	53.3
Montreal Light Heat & Power Co.	185,550	945,200,656	58.1
City of Winnipeg Hydro Electric System	38,048	144,509,000	43.4
UNITED STATES			
Niagara Falls Power Co.	328,826	2,252,249,000	78.2
Commonwealth Edison Co.	600,000	2,225,442,875	42.3
New York Edison & United Light & Power Co.	497,577	1,659,269,781	38.1
Pacific Gas & Electric Co.	293,708	1,608,940,735	62.5
Southern California Edison Co.	239,160	1,198,926,369	57.2

Water Power Development of Canada.

THE Dominion Water Power Branch of the Department of Interior, Ottawa, has issued a bulletin dated February 1, 1923, in which it outlines the progress made in the development of the water powers in Canada during the past year. This report shows statistics which are of particular interest as shown by the following extracts:

The 2,973,759 h.p. at present installed in this country may be classified as follows:—

2,204,486 h.p. in central stations for general distribution for all purposes.

484,228 h.p. installed in pulp and paper mills, not including 160,577 h.p. purchased by pulp and paper companies from central stations.

285,045 h.p. installed in industries other than central stations and pulp and paper mills.

The total installation for the Dominion averages 338 h.p. per thousand population, a figure which maintains Canada's position as second only to Norway in the per capita utilization of water power among the countries of the world.

Modern developments in high tension electrical transmission, which permits the economic transportation of power at small loss over relatively long distances has made possible the use of hydraulic power for manufacturing in established centres where labor is plentiful and of a permanent character, with shipping and distributing facilities readily at hand. Such centres, with their variety of manufacturing needs and processes, street railways to be operated, buildings to be lighted and heated, municipal needs for street lighting and water pumping, form an ideal market for the product of the central electric station and have resulted in the central station industry attaining enormous proportions in a relatively short period of time.

Throughout the Dominion at present there are 273 hydro-electric central stations with an installed turbine capacity of 2,204,486 h.p. or a generator installation of 1,636,084 kv.a. of which totals 1,556,956 h.p. is installed in commercial or privately owned stations while 647,530 h.p. is installed in municipal or publicly owned stations.

The units vary in size from 10 h.p. to the 55,000 h.p. turbines recently installed in the Queenston development of the Ontario Hydro-Electric Power Commission, and which are the largest operating water turbines in existence at the time of writing. The turbine units in the industry average 3,483 h.p. while the average installation of the central stations is 8,075 h.p.

Unremitting progress in operating efficiency and wider fields of service are being constantly maintained by the operating companies and interested government departments. New units are being installed, new plants constructed, new projects investigated and research instigated to meet the

growing domestic and industrial demand and to link up the hitherto isolated small centres and rural districts with cheap hydro-electric power.

The growth of water power developments in Canada has been striking. Total installed horse power has grown from 975,000 to 2,974,000 since 1910, central station installation from 605,000 to 2,204,000 h.p. and pulp and paper installation from 191,000 to 484,000 h.p.

There is every reason to believe that this rate of growth will not diminish. New uses for electric current of the greatest import in industrial processes and services are being constantly discovered. Canada's strategic advantage in the location of large reserves of water power within transmission distance of her centres of population should attract special industries to these centres in increasing numbers. Population follows industry and at once an added market is created for power for domestic and municipal uses. All the modern tendencies in the utilization of cheap power indicate that the rate of growth of hydro-electric development in Canada will increase rather than lessen.

Should the rate of installation since 1910 be maintained at its present rate there will be installed in 1925, 3,360,000 h.p.; in 1930, 4,110,000 h.p.; in 1935, 4,800,000 h.p.; and in 1940, 5,600,000 h.p. These growth figures are considered conservative. Available reserves are more than ample to take care of these future demands, as outlined, for a long time to come.

The water power now developed in Canada represents an investment of over $620,000,000. In 1940 should the rate of growth in installation during the past fifteen years be continued, this investment will have grown to over $1,100,000,000. The present development represents an annual equivalent* of 26,700,000 tons of coal which, valued at $10 per ton, represents $267,000,000. In the year 1940 these annual figures will, with the foregoing assumption, have become 50,000,000 tons and $500,000,000. These figures are striking evidence of the outstanding importance and necessity of an intelligent administrative policy governing the development of our water power resources.

*Relatively few persons appreciate the enormous quantity of coal representing, from a power standpoint, the equivalent of the amount of water power developed, even at the present time, in Canada. The amount of this coal equivalent will vary according to the selection of the basic elements employed in its computation. The Dominion Water Power Branch in the "Bulletin" above referred to presents its estimate of the equivalent in the words here quoted.—Editor.

DEVELOPED WATER POWER IN CANADA

Province	Turbine Installation in H.P. in Central Stations	in Pulp and Paper Mills	in Other Industries	Total	Population Census of June, 1921	Total Installation per 1000 population.
1	2	3	4	5	6	7
British Columbia	227,401	48,800	52,776	328,977	524,582	627
Alberta	32,380		687	33,067	588,454	56
Saskatchewan					757,510	
Manitoba	117,625		16,400	134,025	610,118	220
Ontario	1,018,853	171,024	109,353	1,299,230	2,933,662	443
Quebec	761,480	231,737	80,666	1,073,883	2,361,199	455
New Brunswick	21,113	14,668	6,258	42,039	387,876	108
Nova Scotia	15,346	17,999	13,755	47,100	523,837	90
Prince Edward Is.	288		1,951	2,239	88,615	25
Yukon	10,000		3,199	13,199	4,157	3,175
Canada	2,204,486	484,228	285,045	2,973,759	8,788,483	338

Column 2 includes only hydro-electric stations which develop power for sale.

Column 3 includes only water power **actually developed** by pulp and paper companies. In addition to this total, pulp and paper companies purchase from the hydro power central stations totalled in column 2, 72, 122 h.p. in Ontario and 88, 455 h.p. in Quebec. The total hydro power utilized in the pulp and paper industry is therefore **644,805 h.p.**

Column 4 includes only water power **actually developed** in connection with industries other than the central station and the pulp and paper industries. These industries also purchase blocks of power from the central stations totalled in Column 2.

Column 5 totals all turbines and water wheels installed in Canada.

Column 6 Total population includes 7988 in North West Territories and 485 in the R. C. Navy.

Column 7 averages the developed water power per 1000 population.

DEVELOPED WATER POWER IN CANADA UTILIZED IN THE CENTRAL STATION INDUSTRY

Province	Commercial Stations			Municipal Stations			Total					
		Installation			Installation			Installation				
	No.	Generator K.V.A.	Turbine H.P.	No.	Generator K.V.A.	Turbine H.P.	No.	Generator K.V.A.	H.P. per turbine Unit	H.P. per Station	Total Turbine H.P.
British Columbia	23	141,686	217,356	8	6,353	10,045	31	148,039	3,990	7,335	227,401
Alberta	3	22,250	32,380				3	22,250	2,491	10,793	32,380
Saskatchewan	3	37,350	50,400	2	57,312	67,225	5	94,662	5,881	23,525	117,625
Manitoba	67	387,159	492,025	37	353,362	526,828	104	740,521	3,742	9,796	1,018,853
Ontario	77	582,413	743,855	16	13,202	17,625	93	595,615	3,541	8,188	761,480
Quebec	7	6,585	9,203	3	9,363	11,910	10	15,948	960	2,111	21,113
New Brunswick	8	1,479	1,449	11	11,239	13,897	19	12,718	667	808	15,346
Nova Scotia	7	331	288				7	331	32	41	288
Prince Edward Is.	1	6,000	10,000				1	6,000	5,000	10,000	10,000
Yukon											
Canada	196	1,185,253	1,556,956	77	450,831	647,530	273	1,636,084	3,483	8,075	2,204,486

Commercial Stations include all privately owned.

Municipal Stations include all publicly owned.

Note:—Statistics is this table are based upon a census of the industry made by the Dominion Bureau of Statistics in co-operation with the Dominion Water Power Branch.

Inspections Build Business and Good Will

By H. A. FEE,

President Citizens' Light & Power Company, Adrian, Mich.

MAINTAINING customers good will and keeping energy-consuming devices on the line is a problem of no less importance to a small public utility than it is to a utility serving several hundred thousand customers. Often the personal relationships between a small utility and its customers can be, if properly handled, much more intimate and cordial than is possible with a larger utility. The extent to which a small utility will benefit by these relationships will depend upon its service to its customers "above and beyond its actual call of duty."

One of the most effective methods of having consumers view their local company in a favorable light is a free inspection service. Such a service has now been in use in Adrian, a city of twelve thousand inhabitants in lower Michigan, since 1912. During 1922 our inspector made twelve thousand visits among our three thousand consumers. This inspector follows the regular meter route with an electric truck carrying lamps and appliances, which he demonstrates and sells. He works the territory on schedule so that four complete inspections are made yearly. This work has continued ever since it was started, with the exception of the war period. At that time our inspector entered the nation's service, but the inspection trips were resumed in the year 1919 after customers had urged that they be restored.

Although in the beginning the inspector reported frequent trouble in gaining entrance because of housewives' suspicion of the company's object, the service is now so popular that oftentimes a customer will call up to determine just when the inspector will be around again. With such intimate contact with customers no introduction card is presented, although the inspector always carries credentials explaining the purpose of the investigating service.

A loose-leaf notebook is carried by the inspector which gives the name and address of each customer. It also has room for four additional names in case any new tenants move in. White sheets are used for residential customers, while for commercial users buff colored sheets are used. Space has been provided to enter the number and the wattage of lamps and to list the appliances in use. However, as a result of protests from some residential customers against the visiting of all rooms in search of outlets or to determine the lamp watt-

ages, the inspector now merely asks the number of outlets and figures the residence load on the basis of a 50-watt equivalent per socket. On the reverse side of this sheet, columns are provided for the date of inspection, demonstrations and remarks regarding the quality of service. Careful note is made of all comments. If the complaints are not remedied by the inspector on the spot, he refers the subject to the repair department, which issues a regular work order for repairs. It is also his duty to explain any interruptions to service and to bring about adjustment on real or fancied grievances.

The inspector makes an investigation of the service, looking for low-hanging wires, loose brackets or switches and examines service entrance switches. He also inspects appliances. Minor repairs on appliances, sockets or wiring are made free of charge, but when further repair work is required the device is taken to the store with the customer's permission and repaired, this work being charged for according to the material and labor required. Labor in repairing appliances is generally furnished free, however, provided that the time consumed does not exceed fifteen minutes.

After doing his best in repairing appliances and bringing service to the 100 per-cent mark, the inspector tactfully suggests the use of some other appliance the housewife needs. If she appears interested, he steps out to his truck and brings it in. By effectively demonstrating its use he is often able to overcome reluctance to purchase. The sight of an appliance in actual use in the home often is the main selling point in closing a sale.

The part of the service most appreciated by the customer is the sale of lamps. Customers are prone to forget to buy lamps to replace those burned out and as a result of this forgetfulness get along with a lower consumption of energy than normal, without any desire to practice rigid economy. The fact that most of our sales from the truck are of lamps shows that the service helps to keep the sockets full and in use.

After the day's work the inspector makes out a report showing the number of appliances demonstrated, the number of sales made and the number of hours devoted to inspection. These reports are checked daily by the secretary of the company, who supervises the service. No itemized list of various types of appliances inspected has been kept, since this would involve extra time for an office clerk in filing and making out reports. The inspector's route books are turned over to a listing clerk who posts upon permanent cards the load data contained therein. From these cards figures are taken when calculating the distribution capacity required by the residential consumers.

From the results of this service in keeping appliances in good working condition, together with the spirit of good will fostered by maintaining an effective contact with the company, we have found that

the improved customer relationship more than offsets the expense of the service itself, which last year cost us only $1,692. When the customer is made to feel that the company is directly interested in seeing that he gets good service he soon comes to realize that it is made up of human beings like himself and that its officers and men alike are interested in giving him personal as well as mechanical service. With this attitude bills are cheerfully paid. From our early experience we came to believe that the average customer appreciated the convenience of being able to get new tungsten lamps from the inspector far more than he did the saving he made in the cost per candlepower of his lighting service. It was the personal element of the service that appealed to him, and so beneficial have been the results from our free inspection that we would not think of doing without it. We believe there is no better way of building up good will.

—Electrical World.

Methods of Standardizing the Accuracy of Electrical Instruments.

By PERRY A. BORDEN,

Assistant Laboratory Engineer, H. E. P. C. of Ontario.

The following article concludes a series of three papers dealing with the use of electrical measuring instruments. In the first of these a full discussion was given of the sources from which errors might intrude themselves into a system of measurements, together with some suggestions as means of obviating such as did not necessitate structural changes in the equipment. In the second paper attention was given in some detail to such adjustments as were naturally internal to the instrument and in many cases could not be performed without reference to a standard of accuracy. In the following parapraphs these standards will be discussed, showing the functions of the different types, and the principles of some of the more interesting. Information is also given as to the usual methods of recording and utilizing the calibrations of instruments and instrument transformers.

HOWEVER great the mechanical and electrical refinements entering into the construction of a measuring instrument, it is manifestly of little use for the purpose of its design unless a knowledge of the significance of its scale divisions is available. In the early days of electrical development, when each experimenter was confronted with the problem of designing and constructing his own measuring equipment, it was frequently necessary to determine the scale constants of each individual instrument by tedious and intricate mathematical computation. It is at once apparent that if such practices were necessary to-day, the whole development and utilization of electrical energy would be under a tremendous handicap. As it is, however, electrical instruments have been made available for all classes of measurement, and the user need trouble himself little about the accuracy of their scales within their specified limits, as long as the ordinary precautions of use are reasonably adhered to.

Instead of being required to compute the value of each and every instrument scale nowadays, it is necessary only to compare the instrument with standard instruments, which in their turn are referred to standards of a higher order, so that the actual laborious computation of units is confined to the standardization laboratories, which are well equipped to perform such work.

Standard instruments may be classified according to their degree of precision and sensitivity, into several grades, and this classification varies somewhat, according to the principal uses of the instruments and meters which are placed in comparison with these standards. In general, there may be said to be three classes somewhat as follows:

(a) Working Standards
(b) Primary Standards
(c) Fundamental Standards.

(*a*) *Working Standards.*

Under this general classification may be found all instruments used as standards of comparison for the meters and other instruments employed in actual commercial measurements. In general this class is rather indefinite, as it frequently happens that an instrument which will serve for a standard in one instance, may in another case be required for actual measurement work where a comparatively high degree of precision is required. The portable instruments used in checking graphic meters and other switchboard instruments in the field may be considered as under this head, for while they serve as standards for this checking work, they at the same time find use in many actual electrical tests. But, in general, working standards are instruments of types similar to those used in the field, but usually of superior mechanical construction, and longer scale. These instruments may be of the permanent magnet type, usable on direct current only, or of the electrodynamic type, which is usable on either direct or alternating current. In either case it is practically imperative that they be capable of being checked on direct current. The working standards are, (or should be) used with the greatest of care and are protected from vibration, overload and all the other influences, which make for error in electrical measurement.

In the checking of watthour meters in the shop or factory, the reference instrument used usually takes the form of a standard watthour meter, better known as a "Rotating Standard", which is practically identical in its construction with the ordinary type of service instrument, but fitted with a variety of ranges, and having its dial so arranged that fractional divisions of revolution of the moving element may be observed. The rotating standard, in turn, is checked against a long scale precision instrument in conjunction with a standard timepiece.

(*b*) *Primary Standards.*

Primary Standards include that equipment which is used for fixing and determining the accuracy of

the working standards. This includes standard cells, standard resistances and a potentiometer. With these the values of electromotive force, resistance and current can be accurately measured in terms of the fundamental units. Accessories to the potentiometer are:—a storage cell for supplying the current, a regulating rheostat, volt-box and galvanometer.

Primary standards are not suitable for general use but are employed only for the purpose of checking the secondary standards, and are generally usable on direct current only. The potentiometer is an exceptionally interesting device, in that while its principle is exceedingly simple, it may be used for the measurement of electrical quantities to an almost unlimited degree of precision. In its elementary form, the potentiometer consists in an extended wire of uniform resistance and cross section, across which is applied a definite and known electrical potential difference. By the fundamental laws of electric currents, the fall of potential across any portion of this wire, due to the current flowing in it will be in direct proportion to the resistance and therefore to the length of that part. By a proper selection of the material and dimensions of the conductor, it is thus possible to determine to a great degree of accuracy, the relation between the voltage across the whole wire and that across a portion of it. For instance, if the voltage applied to the conductor have a value of 2 volts, it follows that that across one-half its length will be 1 volt, and that across one-tenth, 0.2 volts, etc. This condition, of course, only holds where no current is flowing through the tap off the wire, thus necessitating that the measurement be made by a "zero" method.

The actual operation of the potentiometer in conjunction with the standard cell may easily be understood by reference to Fig. 1, which shows a simplified diagram of the instrument manufactured by the Leeds and Northrup Company of Philadelphia. Here the conductor to which a constant potential difference is applied, is represented by OB and the voltage which it is desired to measure, by the battery cell "X-E.M.F.". W represents a small storage cell which supplies current to the potentiometer wire through the regulating rheostat R. AB represents the graduated portion of the resistance, upon which slide the two contact

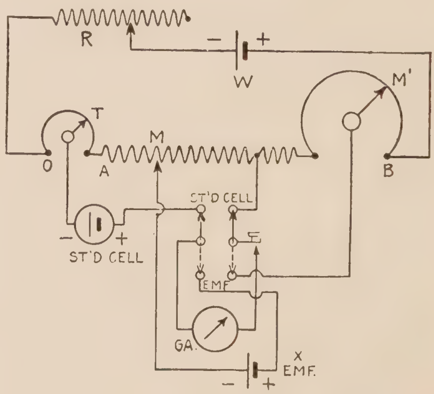


Fig. 1.

Simplified Diagram of Potentiometer, with Standard Cell.

points M and M^1. the portion upon which M travels is divided into comparatively wide graduations, while the extended wire covered by M^1 can be read by a vernier to a very small fraction of its length.

The double-throw switch in the diagram is for the purpose of quickly changing over from the standard cell to the voltage under measurement. It will be noted that when the switch is thrown to its upward position, the standard cell is applied to the potentiometer between a fixed tap and an adjustable point T on the portion OA of the potentiometer wire. This is made adjustable, so that the instrument may be adapted for the voltage of the standard cell. These cells have a slight variation among individuals, and at different temperatures, the average being about 1.0186 volts: and before adjusting the potentiometer current the arm T is set to the voltage of the cell which is being used as a standard. With the cell correctly applied to the potentiometer, the galvanometer key is depressed, and the rheostat R adjusted until a balance is obtained, at which time there will be no current flowing in the galvanometer; thus signifying that the voltage across the tapped portion of the wire, due to the main current flowing in it is equal to that of the standard cell, and that therefore, the current is at its correct or standard value. When this condition obtains, the instrument is ready to be used for the measurement of the unknown voltage. To do this, the throw-over switch is placed at "E.M.F.", which applies the unknown voltage to the slide-wire between the points M and M^1, the circuit being completed, as before, through the galvanometer and key. The deflection is observed, and a balance obtained, not in this case by adjusting the main current, but by moving the points M and M^1 until the galvanometer shows a zero indication. It is then evident that the voltage between these points due to the source under investigation is equal to that across the portion MM^1 of the slide-wire, which voltage can be precisely determined by observing the graduations at which these points lie.

Although it has already been pointed out, the fact deserved emphasis that when the galvanometer shows a balance, no current is taken from the source, the potential difference of which is being measured. The importance of this observation is that, under the conditions of the measurement, the source of electromotive force undergoes no change due to the measurement. Thus voltages may be measured, not only to a high grade of precision, but without any disturbance whatever, even though they be derived from very high resistance sources.

In the measurement of voltages of values higher than the range of the potentiometer, (usually 1.6 volts), resort is had to what is known as the "Volt box". This is merely a potentiometer having one or more fixed taps, set at certain definite ratios of the total resistance. If a measurement of a volt-

age in the neighbourhood of 110 were to be performed, this voltage would be applied in the volt box, and the 1/100 tap led to the potentiometer, which would mean that the actual measurement would be performed on a voltage of about 1.1 volts,—well within the range of the instrument. At the same time, as under the conditions of measurement no current flows in the tap, the resistance ratio would represent the true ratio of voltages.

When currents are to be measured, the volt box is replaced by a standard resistance. This is, as its name implies, a resistance whose value is very accurately known as compared with fundamental standards, through which the current to be measured is caused to flow. The resulting voltage drop between the terminals of the resistance is then led to the potentiometer and measured; and as there is no current flow in the interconnecting circuit, no correction need be made for the resistance of the instrument or the leads. Knowing the voltage drop and the value of the resistance, the determination of the current becomes a very simple matter.

The potentiometer as actually used has a number of elaborations which make for convenience and rapidity of operation, but the principle remains exactly as has been described. There is also an instrument known as the "Deflection potentiometer", in which a current flows in the galvanometer circuit during the time of measurement, the effect of this current being automatically corrected out, and the final reading being made upon the calibrated scale of the galvanometer. This instrument, while somewhat more flexible and rapid in its use than the simple potentiometer, is not so precise or so likely to stay in calibration. The principle of the potentiometer is, of course, applicable on alternating currents, but the operation of the necessary accessories is much more intricate, and the detection of a condition of balance a rather complicated matter. In general, as has been stated above, alternating current instruments are checked against instruments which may be used on either current,—"transfer instruments"—, and the calibration of the latter determined by means of a potentiometer.

It will be noted that the accuracy of the potentiometer and the volt box does not depend upon the accuracy of the resistances of the circuits, but only upon the accuracy with which the relations of the component resistances in the one instrument are known. Thus, a potentiometer may be checked with an ordinary Wheatstone Bridge, and even though an error should exist in the absolute value as measured by the bridge, this error need not be reflected in the potentiometer. The constants of the standard cell and of the standard resistances must be known and it is here that the fundamental standards find their place. Of course, in the ordinary instrument laboratory there may be, and usually are, kept several standard cells and resist-

ances, so that they may be periodically inter-compared, thus giving a reasonable degree of assurance of maintained accuracy, but the ultimate standard of reference must be something of an even higher grade.

(*c*) *Fundamental Standards.*

There are a number of types of fundamental standards, and these are devices which bear little resemblance to electrical equipment in the ordinary sense of the word. To produce the fundamental standards the aid of the chemist has been called in to a very large extent. The standard cell, of course, is really a production of the chemical laboratory rather than the electrical, but it is not considered as a fundamental standard, being rather in the class with primary standards. The fundamental standards are the International Ohm, and the International Ampere. The Ohm is the resistance of a column of mercury, of a certain degree of chemical purity, of certain strictly defined physical dimensions, and at a certain very definite temperature. The Ampere is that current, which flowing for a specified time through a metallic solution of a certain strength and, of course, at a certain temperature, will deposit out of that solution in a given time, a specified weight of the metal. It is at once evident that these standards would be of little use for ordinary commercial measurements, but they have the essential characteristic that they may be duplicated at any time and in any properly equipped place without reference to any further electrical measurement. Probably the sole example of the employment of the principle of a fundamental standard in commercial work lies in the old electrolytic meter, sometimes used in the measurement of direct current as sold to consumers.

Other fundamental standards employing magnetic principles have been developed and serve as useful checks on the ultimate accuracy of electrical measurement, but those which have been named will serve to establish a basis for all electrical measurement. These fundamental standards are maintained at the various national laboratories and periodically intercompared.

The Checking of Instruments.

While it is sometimes necessary in determining the accuracy of instruments, to connect the standards into circuit with them while in service and compare readings under actual load conditions, this procedure should be avoided whenever possible and the check performed upon an "artificial" load which is under perfect control of the person making the test. It is then possible to set the instruments at any desired point of the scale and compare the accuracy with the indicators at rest. In laboratory practice, the standard instruments are kept set up on testing tables, with means immediately at hand for producing and regulating the test current. As laboratory standards usually have longer and more finely divided scales, it is more con-

venient to set the pointer of the instrument which is under test at each point where it is desired to check, and read the indication of the standard instrument at the same time. In some cases it may be necessary to reverse this process, and make the final reading and interpolation upon the scale of the meter being checked, but, whenever possible, this should be avoided. Several readings are usually taken at each point and any slight discrepancies averaged out. If discrepancies on successive readings are found to be unreasonably large, it may be assumed that there is trouble in one of the instruments and this must be eliminated before the test can be carried on. In the case of electrodynamic instruments, checked on direct current, reversed readings should be taken, and the results averaged.

The comparative readings, once obtained, must then be expressed either in a tabular or graphic form, and, as there are a number of methods of doing this, it is as well that some attention should here be given to this matter. In tabulating the results, the various cardinal or numbered points of the instrument under test are usually taken as reference points, and the actual accuracy of the meter for each of these given in the record. This accuracy may be expressed in any one of three ways: either as the actual quantity in the instrument when the pointer gives a certain indication, or as the error of the instrument at that point, or as the correction which must there be applied to the reading to obtain the actual value of the quantity. It is evident that the error and the correction must be equal quantities, but opposite in sign, while the sum of the indication of the instrument and its correction will represent the true quantity. In instruments which are used for commercial measurements only, it is probably best to express the calibration in terms of correction, while with instruments which may be employed as standards for other instruments, the calibration should be expressed as error. In any case, as both practices are in use, great care should be exercised in the use of calibration, to see that the values given are used in their proper sense, as otherwise the errors which may exist in the instrument will be doubled. The tabulation given in Fig. 2 shows how these figures may be handled, introducing the correction necessary for the error of the standard and also shows the calibration finally expressed in several ways. The purposes of the "Error", and "Correction" columns has already been explained. The "Actual Watts" column serves a valuable purpose in eliminating the possibility of error in the use of either of the former columns due to mistaken sign. The "Percent Error" column, which expresses the error in per cent. of the indication, and not of the full scale, is of value when using the instrument as a standard of comparison for a watthour meter, where the error of the meter can only be conveniently expressed in

CALIBRATION DATA SIMPLEX WATTMETER, STYLE "M-34" No. 553 750 Watts, 150 Volts, 5 Amperes. Checked on 60 cycles.						
Indication of Meter	Error of Meter as read	Error of Standard	Actual Error of Meter, Watts	Correction of Meter, Watts	Actual Watts in Meter	Error of Meter Percent
0	0	0	0	0	0	0
50	+1·3	-0·1	+1·2	-1·2	48·8	+2·40
100	+2·5	-0·2	+2·3	-2·3	97·7	+2·30
150	+3·1	-0·1	+3·0	-3·0	147·0	+2·00
200	+3·5	-0·3	+3·2	-3·2	196·8	+1·60
250	+3·6	-0·4	+3·2	-3·2	246·8	+1·28
300	+3·8	-0·4	+3·4	-3·4	296·6	+1·13
350	+2·8	-0·3	+2·5	-2·5	347·5	+0·71
400	+1·5	-0·4	+1·1	-1·1	398·9	+0·28
450	+0·2	-0·6	-0·4	+0·4	450·4	-0·09
500	-0·8	-0·1	-0·9	+0·9	500·9	-0·18
550	-1·3	-0·6	-1·9	+1·9	551·9	-0·35
600	-1·9	-0·8	-2·7	+2·7	602·7	-0·45
650	-2·5	-1·1	-3·6	+3·6	653·6	-0·55
700	-2·6	-1·3	-3·9	+3·9	703·9	-0·56
750	-3·8	-1·6	-5·4	+5·4	755·4	-0·72

Fig. 2.
Method of Expressing Calibration data in Tabular Form.

terms of per cent. In Figs. 3, 4 and 5 respectively, appear copies of calibration cards, such as are used in the Hydro-Electric Power Commission's Laboratories, showing the calibration of the same instrument expressed in terms of error, correction and percent indication respectively. It will be noted that the graphs take the form of zig-zag lines, rather than smooth curves and a word in explanation of this may be in order. Smooth curves logically express the relation between two quantities, each of which follows a definite mathematical law; but with indicating instruments, it must be remembered that the cardinal points, as originally marked, were determined by reference to a standard, and individually calibrated, the intermediate points afterwards being located by interpolation. Thus, each point is likely to have its individual error, without reference to the adjacent points, and the logical expression of the calibration lies in joining the several calibrated points on the curve by straight lines. A smooth curve, as shown dotted in Figure 3 gives the general trend of the calibration of the instrument, and in this case would indicate that something had happened to disturb the proportion-

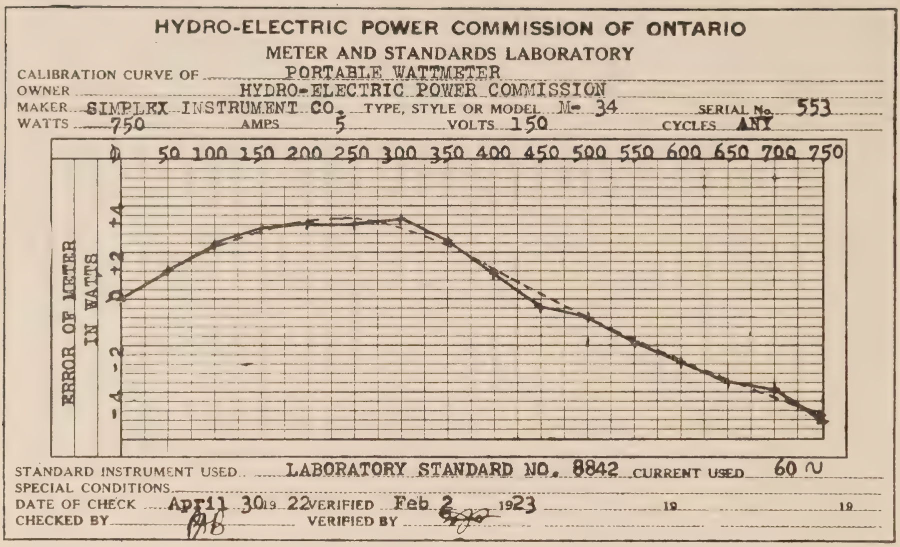


Fig. 3.
Wattmeter Calibration Curve, Showing Error In Watts.

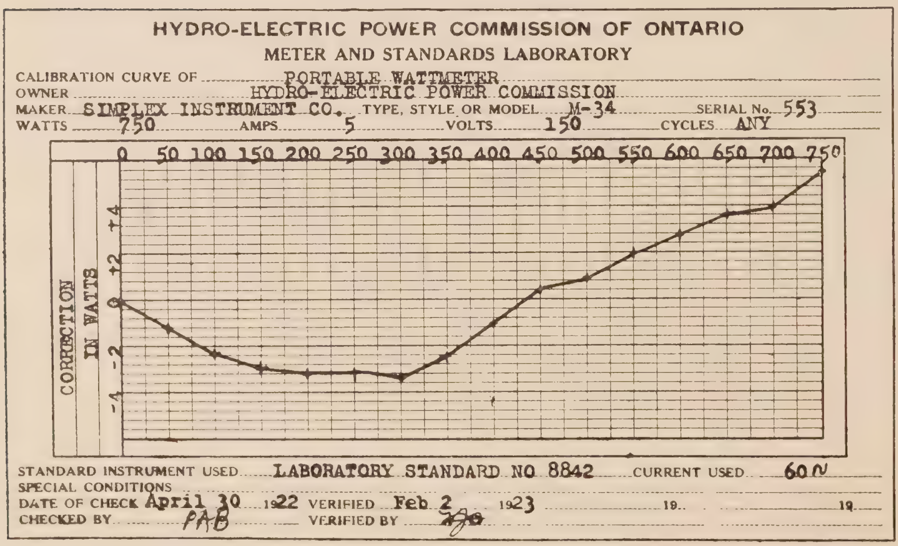


Fig. 4.
Wattmeter Calibration Curve, Showing Correction in Watts.

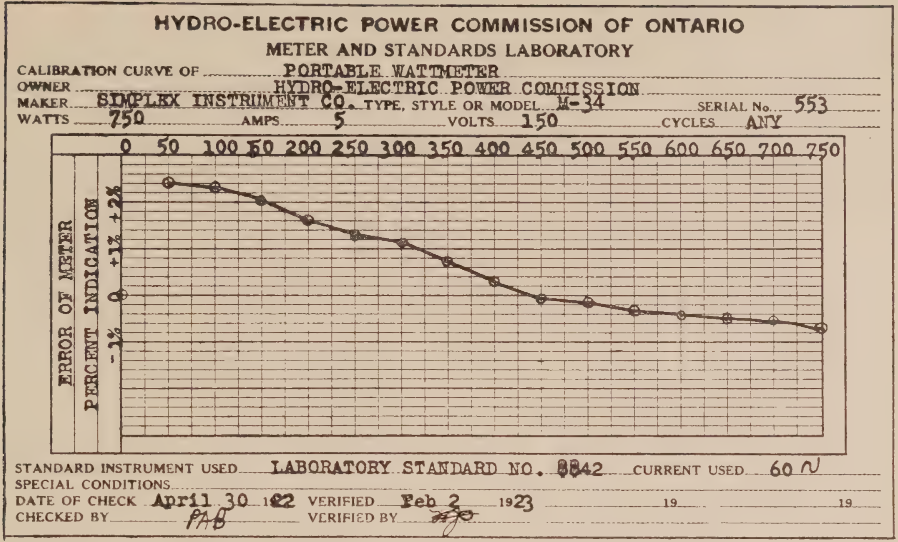


Fig. 5.
Wattmeter Calibration Curve, Showing Error in Per Cent of Indication.

ality of the scale, since first determined. In some instances, as in the case of graphic meters whose charts are read by engine-divided scales, or such instruments as the Westinghouse Precision type, having a uniformly divided, machine made scale, the correct type of calibration graph would be a smooth curve.

Instrument Transformers.

Voltage transformers and current transformers are used in conjunction with measuring instruments on alternating current circuits at times when the voltage or the current in the circuit to be measured is not within the range of the instruments available, or when it is desired to insulate the instrument from the circuit under test. In a perfect instrument transformer the nominal ratio of the device would hold good and the primary and secondary current or voltage would be exactly in phase agreement (or opposition) under all conditions of operation. Owing to energy losses in the windings and in the magnetic circuit of the transformer, as well as to inductance of the coils, this condition is not realized, and the transformer can not be exactly correct at all times. It is usually possible to so compensate a transformer that it will be correct under one or more specified conditions, but the "universal" instrument transformer is yet to be developed. Fortunately, by careful design and selection of material, it has been possible to produce instrument transformers whose errors, except when extreme accuracy is required,

may safely be neglected. It is also possible to determine with great precision the actual errors which may exist in transformer constants, so that when correction is required, the data are readily available.

The voltage transformer is essentially identical with the ordinary power transformer, and in consideration of the conditions under which it is used, is comparatively easy to bring to a high degree of accuracy. Generally speaking, this transformer is used over a comparatively small range of voltage and the only problem in design is to have the regulation sufficiently good that changes of secondary load will not carry its radio outside of specified limits. In the current transformer, there is a double problem to solve, in that not only are the constants of the transformer widely effected by the burden which may be imposed upon the secondary circuit, but that the transformer is usually required to maintain a reasonable constancy of accuracy over a very wide range of primary currents. A great deal of study has been given to this matter and many ingenious methods resorted to in order to compensate for the sources of error, with the result that the current transformer intelligently used may generally be depended upon to furnish results whose accuracy is well within the limits demanded by ordinary indicating instrument.

Instrument transformer accuracies may be determined either by absolute methods or by comparison with standard transformers of similar ratio whose constants are very accurately known. The absolute methods include direct comparisons of primary and secondary through the medium of standard resistances as well as a variety of methods using standard inductances and three-coil transformers. The results of accuracy tests are usually expressed in terms of per cent error, or some function thereof, rather than as the actual absolute quantity by which the device may be in error. Phase angle errors are expressed either in minutes and seconds or in decimal parts of a degree, and care must be taken to specify whether the primary or the secondary is the lagging, as there are conditions where the phase angle may change from one to the other in the individual transformer.

In applying the corrections for instrument transformer errors, the phase angle seldom requires consideration except in the case of the wattmeter. For voltage or current measurements, the ratio alone is sufficient to establish the accuracy of the measurement. When a wattmeter is used, particularly for polyphase work or on low power factors, care must be taken that the phase-angle does not affect the readings, as a difference between the phase angle of the currents representing the load under measurement and that between the corresponding currents within the instrument may introduce consider-

able errors. As correction for phase-angle is a rather complicated process, requiring the application of trigonometrical formulae, effort should be made to avoid instances where this might be necessary.

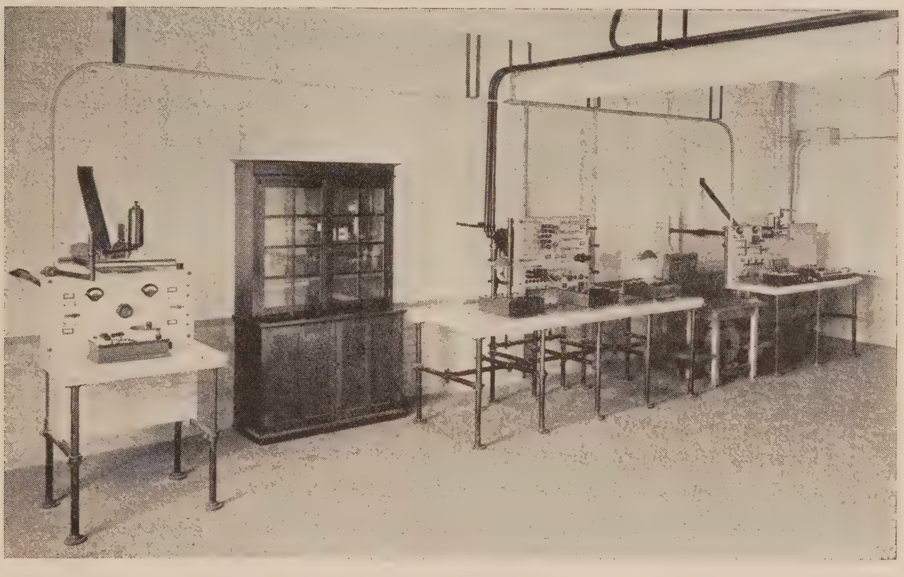


Fig. 6

PORTION OF STANDARDS ROOM IN COMMISSION'S LABORATORIES, SHOWING POTENTIOMETER (*at left*) AND LONG-SCALE LABORATORY STANDARDS (*centre*). *Dust-proof cabinet contains primary standards of voltage and resistance. Bridges for resistance measurement seen at extreme right.*

Be Sure to Come

A. M. E. U.

CONVENTION

at Orchard Park Inn

ORILLIA

June 13, 14 and 15, 1923

Hydro News Items

Central Ontario System

The change of primary voltage in Bowmanville to 4,000 volt. "Y" has been approved. This change will permit large increases of load without change in the distribution copper.

* * *

The Presqu'ile Park Commission has granted a franchise to the Presqu'ile Summer Hotel Co. to distribute electric power at Presqu'ile Park, near Brighton. The Company has applied to the Commission for a block of power.

* * *

Rural extensions are planned for this season on the Kingston Road (West) and the Wooler Road (North) from Trenton.

* * *

Orders-in-Council were passed April 20th. authorizing the construction of generating stations at Dam 8 and Dam 9 on the Trent Canal System. Construction will start at an early date.

* * *

Rates have been approved for service to Summer cottages at the Lake near Newcastle. These rates are based on the fuse rating of the service box.

Eugenia System

Arrangements are about completed for connecting the Niagara and Eugenia Systems by means of a tie line from Harriston to Mount Forest with the installation of a 1,000 h.p. frequency changer at the Mount Forest end. This frequency set with the addition of a second pipe line at Eugenia, tenders for which are being called for and which will close June 1st., will enable the Commission to obtain the full capacity of the present installed equipment at Eugenia, which is 8,000 h.p. The minimum possible increase with this combination at Eugenia is approximately 2,500 h.p., and if it is possible to operate the frequency set at the time of the Eugenia peak the combination is capable of increasing the output of Eugenia System by approximately 3,500 h.p. This combination, together with the extension at the Muskoka Development will amply provide for the power requirements of the Severn, Eugenia, Wasdell and Muskoka Systems for the next three or four years and every effort is being made to carry on these extensions with the least possible delay, as all of these plants are now loaded to capacity. Before construction

work is undertaken the plans and figures will be laid before the Association of Eugenia Municipalities for consideration.

* * *

The officials of the municipality of Meaford are making every preparation to secure Hydro service from the Eugenia System during the coming summer. The contract between the Commission and the municipality has been executed and negotiations are now being carried on with the private owned plant in the municipality concerning the purchase of the distribution system on the streets of the Town. Meaford will be fed by the Commission from a transmission line which will tap the Eugenia-Collingwood tie line at the nearest point to Meaford and a stepping down station will be constructed within the municipality with a capacity of approximately 300 kw. It is anticipated that the construction of the line and the reconstruction of the Distribution System will be carried on simultaneously and both will be in operation by Fall of the present year.

* * *

A 4,000 volt transmission line from Chesley sub-station to the Village of Paisley is now under construction and the local officials in the municipality are also reconstructing their distribution system for the purpose of receiving Hydro power as soon as same is available. It is anticipated that the Paisley System will be in operation some time during the month of July.

Muskoka System

The plans of the Commission for extending the Muskoka Development for the purpose of providing for additional power for the Muskoka System as well as the Severn and Eugenia Systems are rapidly nearing completion. The scheme which will probably be adopted will be the installation of two 2,000 h.p. units replacing one of the existing units which has a capacity of 500 h.p. so that the initial installation at this development after the extension is completed will be approximately 5,000 h.p. Provision will be made for adding an additional 1,000 h.p. at a later date with very little expenditure when the demands require such an additional extension to be made. The tie line which is proposed for connecting Muskoka to the Severn Systems will probably be constructed for a transmission voltage of approximately 40,000 volts as about two-thirds of the capacity of the completed plant will be required for the Severn and Eugenia Systems and it appears that a Star connection for this tie line would give more satisfactory results as far as regulation is concerned. As soon as the completed plans and estimates have received the Commission's approval and have been submitted to the Association of the Northern Municipalities, a complete write-up covering this extension to the Muskoka Plant will appear in the Bulletin as a separate article.

The Gravenhurst Sanitarium has completed an installation for its new Hospital and made application to the Local Commission for approximately 250 h.p. to be delivered by the Fall of the present year. The present load of the Sanitarium is approximately 70 h.p.

* * *

Niagara System

Etobicoke Township Hydro-Electric System is making arrangements for an additional $40,000 debenture issue to take care of extensions and improvements to the system.

* * *

The London Public Utilities Commission recently arranged for an issue of Hydro debentures amounting to $175,000 to take care of extensions to the city light and power system.

* * *

The Mimico Public Utilities Commission recently purchased a building to be used for office purposes for the local system.

* * *

Paris Water & Light Commission is at present installing 2-750 kv-a. three-phase transformers in the local sub-station; the work is being taken care of by the Engineering Department of the Ontario Commission.

* * *

York Township Hydro-Electric System recently arranged to purchase from the Toronto Hydro-Electric System that part of the Toronto & Niagara Power Company's distribution system located in the Township. The system purchased will be combined with the present Township lines. Very little of the system will have to be dismantled as there are very few streets on which there are duplicate pole lines.

* * *

Scarboro Township Public Utilities Commission is now negotiating with the Toronto Hydro-Electric System for the purchase of that portion of the distribution system of the Toronto & Niagara Power Company located in Scarboro Township. This part of the Toronto & Niagara Company's system when purchased will be combined with the present Scarboro system.

* * *

Nipissing System

The new Bingham Chute Development which the Commission is providing for serving the municipalities of North Bay, Callander, and Powassan is now in the course of construction and it is anticipated that two new units at this location with an approximate output of 1,200 h.p. will be in operation before the end of the present year. The present Powassan sub-station will be abandoned and this Village will be served direct from the Bingham Chute Plant at generated voltage. Provision is being made for constructing a new pipe line and installing a new unit at the Nipissing Development replacing

one of the existing units by which means the Commission will have available an additional 600 h.p. at this plant bringing the total output up to approximately 2,400 h.p. which, combined with the Bingham Chute Development will give a plant capacity of approximately 3,-600 h.p. for the Nipissing System at the close of the present year. In addition to these extensions, arrangements are being made for procuring additional storage at Cox's Chute as well as the installation of a reserve plant at North Bay to consist of two 300 h.p. Diesel Oil Engines. These changes will enable the Commission to cope with conditions which prevailed during the past year, in the nature of restricted stream flow on the South River and the difficulties experienced on account of power shortage from this means last winter, will be entirely eliminated in the future.

* * *

Severn System

A 4,000 volt. line between Stayner and Wasaga Beach is in the process of construction and arrangements are being perfected for serving the cottages at the Beach by July 1st. At the present time about 110 contracts at this location have been obtained and it is anticipated that this number will be increased to about 200. Practically all of the energy on this extension will be used in the summer resort district at the Beach.

* * *

A transmission line is now being constructed from the limits of Barrie to the summer resort district at Shanty Bay and it is expected that this line will be completed in the course of the next four or five weeks and service given to about 23 customers, most of which are summer cottages.

* * *

Thunder Bay System

Arrangements are being made for providing an additional transmission line from the Nipigon Development at Cameron's Falls to Port Arthur and Fort William, as well as providing two additional generating units and an extension to the Power House to take care of increased loads at Port Arthur and the contract of the Great Lakes Paper Company. An additional bank of transformers is also being arranged for at Port Arthur as the increasing demands for power in this municipality have reached the capacity of the present bank of transformers at the Bare Point sub-station.

* * *

Wasdell System

The construction of the rural system in Mariposa Township, which will be fed from a new sub-station located on the main 22,000 volt line a few miles south of Cannington is now under construction and it is anticipated that the farmers in this district will be receiving Hydro service over the new lines during the coming summer. Approximately 100 contracts have been obtained in this district up to the present time.

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The Goal of Hydro

Optimism backed up by energetic action is bound to bring about the desired end. Examples showing the result of this combination are very numerous among the Hydro utilities, and the case outlined in the following letter extracted from the *Teeswater News* is but an example of what others have done.

Teeswater is doing well, but is going to do better. It is a recognized fact that the maximum benefit can be obtained only when all are participants. Every householder should be a Hydro user, and use it to the utmost. The greater the use the lower will be the rates. "Everybody boost for Hydro" is a good slogan, but when everybody uses it there can be but the one result. Let the utilities continue their efforts until every house, store and factory within the municipal limits becomes a Hydro customer, and to show the many uses to which the service can be put.

Hydro Progress In Teeswater.

A year ago we had to pay what is known as the 13th Power Bill of $1,817.13 to make up our share of the deficit in the year's operating expense for the year that had passed. This year we have a credit sufficient to cover our power bill for Feb., $423.20 which is sent to us receipted together with a credit of $16.00 of an overcharge for January. With the buying of meters and other expenses we had our heavy expenditure the year before last. After all present debts are

paid we will have possibly a surplus of $600. The power taken is almost up to the amount allotted to Teeswater and we have good reasons for expecting to exceed the 150 horsepower mark in the near future. It is too soon yet to predict any reduction of rates but as it is the people's enterprise and managed in their interest that will come as soon as the revenues warrant.

There are still over 80 not taking Hydro who could have it installed. With the revenue from that 80 added to our present revenues the day of lower rates would be very much closer. We are starting a campaign to get that 80 if it can possibly be done. It is by the patriotic support of the citizens of Teeswater and its vicinity that any local enterprise can be made to pay and become a credit to the Village.

Everybody boost for Hydro that we may add that 80 domestic users together with any added power users we may sign up and so increase the revenues as to warrant a reduction in rates. It is a public interest. Do your bit to make it a success and reap the benefit.

(Sgd.) G. S. Fowler,
Chairman Commission.

Rural Electrical Service in Ontario

By J. W. PURCELL,

Assistant Engineer, H.E.P.C. of Ont.

THE construction of high voltage lines through the country from the generating stations to high tension stations, and from them to towns, cities and villages, as well as intercourse between farmers and their town friends, has probably been the main cause of originating a desire in the minds of farmers and residents in rural districts for electric service. The Hydro-electric Power Commission recognized this demand at an early date and on its request, in 1911, legislation was enacted to provide for such electrical service to groups who petitioned for it. Under this legislation service in rural districts was supplied, as in towns and cities, at cost, under a contract between the individual and the township, covered by an agreement between the township and the Commission. These contracts and agreements are for the period of the debenture.

This method of giving service to groups had to be revised at a later date, on account of the apparent injustice which worked to the disadvantage of the man on the back lines of the township.

The demand for information and estimates has increased in about the same proportion as the growth of Hydro-electric service in towns and cities.

A study of the problem of distribution of electricity to country districts is being undertaken from a national point of view, by many countries on this continent and in Europe, incited largely by the shortage of farm labor, caused by the great war which the world has just been through. The consideration, in general, by governments has been from the point of view of giving assistance to rural districts, either by long term loans to farmer companies, or bonusing of these companies. Some countries have now a system of this kind in operation, all of them in Europe. Among them are France, Denmark, and Sweden. The United States of America are at present working in conjunction with a large electrical association, with apparently the same object in view, but in most cases the problem has been viewed from the point of delivery of power from a general distributing point to a receiving centre, all distribution to be taken care of from that centre to the individual, by a company arrangement. We believe that the Hydro-electric Power Commission is the first to undertake in an extensive way the delivery of power direct to the individual in the rural district.

The difficulties of electification of country districts seem to be the same, or nearly so, in all parts of the world. This class of consumer from the viewpoint of the central station, seems to be unprofitable on account of difficulties which are itemized below. The companies in most cases will not consider extending their lines to the consumer, excepting in districts where the requirements for power in the area to be served are considerably larger than the average found in country districts. In most cases such extensions have been made to serve intensive agricultural districts, or areas adjacent to lines that have been extended to suburban districts for the purpose of giving service to individual plants outside of urban centres. In general these difficulties are as follows:—

(a) A small return on capital invested in distribution system and plant.

(b) Distance to be covered in rendering service and in operating the system, resulting in high operating costs per service.

(c) A small load per mile of distribution system.

(d) Low load factor, or small number of hours use of demand by the rural consumer.

(e) Scarcity of power-using industries in the districts to be served, excepting perhaps in the case of those adjacent to the larger cities.

(f) The use by farmers of machinery larger than the work they do would warrant.

(g) Irregularity of demand, weather conditions being a factor in deciding when work should be done, resulting in the use of power by many at a time, when plant demand may be high in urban districts, by reason of the same weather conditions.

The 1911 legislation which was enacted to meet conditions apparent at that time, viz., requests from groups near urban centres petitioning for electric service, was found later to be unfair, and in 1920 this condition was recognized, and legislation was amended to provide for service under the conditions which were found, from actual experience, to obtain. Under this amended legislation, zones or districts are described in which electric service is given to each class, at the same rate throughout the whole district, based on average conditions in the district. By these arrangements the geographical township boundaries are disregarded, the boundaries of the district being the line to which a distribution system could be run from the distribution centre of a town, city or village, economically.

In 1921 legislation was further enacted providing for the bonusing of rural power distribution primary lines up to 50% of their cost.

The rural resident's conception of his needs in the way of electric service is confined at first to lighting, not realizing that his greater need is the use of convenient power. To the latter service he must give the most attention, as it is from this use he can and will effect saving in labor, which makes the use of hydro-electric power on the farm profitable.

In order to overcome the difficulties previously referred to, closer attention must be paid to all the details of construction and operation of a rural power district than in an urban centre. In constructing such a system, such material and labor as can be secured locally must be taken advantage of. Load-factor of systems can be improved by co-operation of manufacturers in the development of a better class of farm power using machinery, with perhaps smaller capacity, thus decreasing the individual demand for power, and extending the use somewhat. In this way smaller motors will be required than would be needed for the driving of the machinery found under average conditions as they exist to-day. The regularity of doing work by machinery will be a natural development, as rural distribution of power extends. The shortage of help will be supplanted to some extent by power in many ways, such as the use of mechanical milkers, automatic water systems, and conveniently arranged machinery, so as to minimize the handling of such produce as is to some extent manufactured for use on the farm.

Industrial uses will develop in rural districts, when convenient power is available for them. In many cases reports show that the improvements suggested effected a great saving in man-help per year. The use of electric light and appliances in the home assist the housewife materially. Such service is stated by many to be equal in value to the whole cost of hydro-electric service on the farm.

Power-using industries in rural districts are found to be few, and most of them are industries which

are found to a greater or less extent in all rural power districts, consisting of brick and tile yards, cheese factories, gravel plants, quarries, chopping and flour mills. Where power is supplied to industries in any rural power district, it materially assists in helping carry the annual charges on the distribution system of the district, thereby resulting in a lower rate to all taking service. It is seldom or never necessary to increase the capacity of the distribution system to serve them, the standard rural line having ample capacity to handle this extra loading.

The small amount of business in country districts will seldom justify extension of lines any great distance to reach the area to be served. The available business in most districts is not more than sufficient to carry a rural distribution system mile by mile. It is also true that few rural power districts at the start will warrant a transformer station. It is essential, where possible, to have lines extended from existing rural power distribution centres of a town, city or village, where such service at a proper voltage is available.

As the petitions from rural residents desiring information were not found to be a reliable basis in every case, on which to make estimates, a minimum business basis of a minimum connected load, per mile, was used to arrive at an estimated rate to those requesting information, the cost of power to be that at the distribution centre from which it is proposed to extend the line.

Distribution systems for country districts are designed to cover the defined zone around the distribution centre from which such service lines would originate. The 236 towns, cities and villages on the 14 Hydro-electric systems are all potential distribution centres from which such systems might be or are being served. The voltage of rural systems is being standardized by the Hydro-electric Power Commission at 4,000 volts, "Y" connection as far as possible. Main lines are usually 3-phase, and branches single phase. The service voltage to consumers is 110 or 110/220 single phase, except in the cases of the heavier farm service classes, which are 3-phase. Construction of service lines on consumer's premises is in all cases undertaken by him, the service meter being centrally located for convenience in distributing to the various farm buildings on his premises, in some cases this location being the transformer pole.

The rates to users in rural districts are based on service at cost, and the same, as in urban centres, is made up of two parts, the service charge and power cost; the former being designed to cover the annual fixed charges and operating costs, the latter in the form of a first and second kilowatt hour charge being based on the cost of power at the point of delivery.

Users of power in townships are required to contract with the townships and may choose, with certain

limitations, from the following classes:—

Class I—Hamlet service includes service in hamlets, where four or more customers are served from one transformer. This class excludes farmers and power users. Service is given under three subclasses as follows:—

Class I-A Service to residences where the installation does not exceed six lighting outlets or twelve sockets. Use of appliances over 600 watts is not permitted under this class.

Class I-B Service to residences with more than six lighting outlets or twelve sockets, and stores. Use of appliances over 750 watts permanently installed is not permitted under this class.

Class I-C Service to residences with electric range or permanently installed appliances greater than 750 watts.

Special or Unusual loads will be treated specially.

Class II-A House Lighting—Includes all contracts where residences cannot be grouped as in Class I. This class excludes farmers and power users.

Class II-B House Lighting—Includes lighting of buildings and power for miscellaneous small equipment and power for single phase motor not exceeding 2 horse power or electric range (motor and range not to be used simultaneously) on a small farm of 10 acres or less in vegetable or fruitgrowing districts, and 50 acres or less in mixed farming districts.

Class III—Light Farm Service—Includes lighting of farm buildings, power for miscellaneous small equipment, power for single phase motors, not to exceed 3 Horse Power demand or electric range. Range and motor are not to be used simultaneously.

Class IV—Medium Single Phase Farm Service—Includes lighting of farm buildings and power for miscellaneous small equipment, power for single phase motors, up to 5 horse power demand, or electric range. Range and motor are not to be used simultaneously.

Class V—Medium 3-Phase Farm Service—Includes lighting of farm buildings and power for miscellaneous small equipment, power for 3-phase motors, up to 5 horse power demand, or electric range. Range and motor are not to be used simultaneously.

Class VI—Heavy Farm Service—Includes lighting of farm buildings and power for miscellaneous small equipment, power for motors up to 5 horse power demand, and electric range, or 10 horse power demand without electric range.

Class VII—Special Farm Service—Includes lighting of farm buildings, power for miscellaneous small equipment, power for 3-phase motors from 10-20 horse power demand, and electric range.

Class VIII—Syndicate—Any customers with a contract in any of the foregoing classes may form a syndicate, provided the summation of their relative class demand will warrant permitting this to be done.

The rates under these contracts are subject to annual revision and adjustment to meet the costs of service in the district. The classifications of services are designed to meet requirements of rural residents, from the experience of the Commission in giving such service extending over a period of years, and are made to fit all the classes

that so far have been represented in applications for service.

In general, the existing sub-station in an urban municipality has been used as the immediate source of power for the surrounding rural community, although in a few instances the rural load has been large enough to warrant the installation of a separate sub-station.

A list of machines, utensils and devices that are commonly found in different combinations in districts that are now being served by the Hydro-electric Power Commission of Ontario, showing the minimum and maximum sizes of motor and the demand of power for each of the machines or utensils is given below. It will be noted that in some cases there are large variations between the minimum and maximum. Detail as far as the records of the Commission are concerned, is available for information on any of the machines on which tests have been run.

Machine or Utensil	Recommended Size of Motor	Demand in Power
Washing Machine	1/6 to 1/4h.p.	1/8 to 1/6 kw.
Electric Iron		5/8 kw.
Toaster		5/8 kw.
Vacuum Cleaner	1/8 to 1/4h.p.	1/8 kw.
Water Pump	1/4 to 2 h.p.	1/6 to 1½ kw.
Cream Separator	1/10 to 1/4h.p.	1/6 to 1/4 kw.
Churn—Farm Size	1/8 to 1/2h.p.	1/6 to 3/8 kw.
Milking Machine	1/2 to 2 h.p.	3/8 to 1½ kw.
Ensilage Cutting Box	5 to 30 h.p.	3-3/4 to 22 kw.
Thresher	5 to 30 h.p.	3-3/4 to 22 kw.
Root Pulper	1 to 3 h.p.	3/4 to 2¼ kw.
Chopper	2 to 20 h.p.	1-1/2 to 15 kw.
Buzz Saw	2 to 10 h.p.	1-1/2 to 7½ kw.
Drag Saw	2 to 5 h.p.	1-1/2 to 3¾ kw.

Electrical energy required for various classes of farm work:—

Silo filling—About ½ ton per kw. h. cut ¾″ long and elevated 40 feet into silo.
Threshing wheat—4 bushels per kw.h.
Threshing oats—6¾ bushels per kw.h.
Chopping grain—Amount of power taken for this work varies greatly. On farm types of machines it has been found that it takes about 1 kw.h. per cwt.
Rolling oats—About 1 kw.h.
Cutting fodder—2 kw.h. per ton.

The Commission's first rural lines were built late in 1912, and between that time and the Fall of 1917, when construction of lines in rural districts ceased, by reason of the high cost due to war conditions, there had been built by it in the Province, 305-½ miles of line, in 81 townships to serve 1,652 individual farms, 1,086 hamlet services, and 6,030 suburban services, a total of 8,769 services, at a total cost of $517,911.77. The primary lines of these systems have been recently bonused to the extent of $154,651.-90. Since June 1st., 1911, the Commission has added, or has lines under construction, to serve the following:—1,710 individual farms; 2,065 hamlet services; a total of

3,775 services, making a total in all districts of 12,544. In addition to the above, there are 2,454 contracts which have not been approved.

Since June 1st., 1921, there have been, or are at present being constructed, 584.59 miles of line, a total capital expenditure of $1,222,569.76. Of this amount the bonus under the Bonusing Act is $351,429.53.

The Art of Conciliation

IN America, when an editor rejects your manuscript he does it either with a curt "Declined with thanks," or else sends a printed slip on which he presents his compliments, which you don't want, and regrets he cannot grant you what you do want. But when an editor in a certain Oriental country finds that your article or poem or story isn't worth the paper it is written on he sends you a letter like this:

"Illustrious brother of the sun and moon—Behold thy servant prostrate before thy feet. I bow to thee and beg of thy graciousness that I may speak and live. Thy honored manuscript has deigned to cast the light of its countenance upon me. With raptures I have perused it. By the bones of my ancestors, never have I encountered such wit, such pathos, such lofty thought. With fear and trembling I return the writing. Were I to publish the treasure you sent me, the Emperor would order that it should be made the standard, and that none be published except such as equaled it. Knowing literature as I do, and that it would be impossible in ten thousand years to equal what you have done, I send your writing back. Ten thousand times I crave your pardon. Behold my head is at your feet—Do what you will—Your servant's servant—The Editor."

Winning The Public's Confidence.

If nothing better could be said about the foregoing letter, it must be acknowledged that the writer had some conception of the Art of Conciliation. The trouble with so many Public Utility employers, is they apparently feel that if brusqueness and abruptness will do the work, why bother about trying conciliation to please? If some interested organization, seeking the truth, were to send broadcast throughout the land this question, "What is the greatest need of the Public Utility Company of today?" the returning answer would be, "The confidence of its patrons in particular and the public in general." There are many phases of a utility company's business which require more than ordinary attention and many problems yet to solve, but the ever present problem is how to eliminate the lingering

prejudice against such corporations. The responsible heads of companies have little difficulty in obtaining the services of competent engineers to construct and operate a property. There is not such trouble in enlisting the financial aid necessary to develop a property if it is located in a thriving territory with growing population, but there is always a difficulty for even the best intentioned corporation when it comes to the question of winning and holding the confidence and good will of a community. The question is often asked, "Why does this unfortunate condition continue to exist?" The answer to the query points in two directions—external reasons on the one hand and internal causes on the other. It is a far cry down the centuries when we look back two thousand years, but before we analyze present conditions it might be profitable to recall some words uttered twenty centuries ago. At that time there lived in Rome a man named Cicero, one of the wisest men whose words and deeds are recorded in the annals of history. He said on one occasion, "It is difficult to tell how much men's minds are conciliated by a kind manner and gentle speech." He must have known that conciliation precedes and induces confidence. If the art existed in Rome in those early days, maybe it can be revived in this country during the present century and applied in such directions as it will do the most good.

The Origin Of Distrust.

Looking at the external reasons for distrust of corporations, we find that there is more than one page of earlier corporation history written over with true stories of greed, aggression and disregard of public rights. Turning from the past we find that there is more than one latter day example of short-sightedness, breach of faith and mismanagement; added to this is the ever present yellow journal, with its failing for startling headlines, inveighing against the so-called Trusts. Then there are the mouthings of the professional agitator, and the theories and vagaries of the self-appointed reform politician. We cannot deny that the yellow journal, the agitator and the politician have had some excuse for their utterances, because of the mistakes, indifference and incivility on the part of the management of some utility companies under their observation, and with whom they have had to do business.

Turning to the internal causes of public distrust, it might be well for each company through its officials to make a self-examination. Much regrettable history of corporations, which has left its mark to prejudice on the public mind, is not chargeable to any present day company, but existing companies are responsible for what goes on within their organizations. If the public to-day does not seem to exhibit complete confidence in all a corporation says and does, perhaps it is not the public that is most to blame.

Development Of Regulation.

The regulation of public utilities by State Commissions has advanced step by step during recent years, and it is inevitable that every public utility company in the United States will eventually be subject to the immediate control of some commission responsible to the people. In the main, patrons, consumers, managers, owners and security holders of such properties have been satisfied with the results thus far achieved. Uniform rates have been established, uniform systems of accounting have been put into effect and in some directions uniform methods of operation have been made possible. Some commissions have very broad powers, and while the distinction between regulation and management is recognized, there is always a possibility that regulation may be extended. If a State Commission has power to dictate what rates shall be charged, what shall be the quality of service and the conditions under which it shall be supplied, then why should it not control the personal treatment which shall be given customers by a public utility through its employers? Are not civility, courtesy and attention as much a part of good service as the rate charged or the voltage delivered? These questions are asked, but such minute supervision is not advocated. However, the trend of the times may bring some surprises in this direction. It would not be an improbable thing for travelling representatives of a Commission to drop into some of the public offices of utility companies, just to learn at first hand how the company treats its patrons across the counters and over the telephones, and through this agency a few company managers might be enlightened about the way their assistants are handling the public. Maybe the trend of the times is pointing to something still more radical. Is it not within the bounds of possibility that some commissions might put a premium upon records of broad public policy and the personal touch in managements, and a penalty may be imposed where a company's reputation in this regard is below a desired standard. Such premiums and penalties might be easily provided when rate fixing investigations are under way. All rates are calculated upon a basis to yield a certain net return on the capital invested. An increase of, say one per cent. above the average allowed would be a handsome premium for some companies, and a decrease of one per cent. would, in some cases, be a severe penalty.

Incentives To Courtesy.

Many officials of companies will say, "Oh, things are altogether different now to what they once were—the public is being well treated." For the present it may be acknowledged that there has been a great improvement in matters of this kind. Managers have sent out correctly worded circular letters with carefully prepared instructions to employees as to how the public must be treated. If instructions given were always car-

ried out, conditions would be ideal. But they are not. Time and again a man may be instructed to be considerate, civil and polite, but he will not unless he so desires. Unless a man has within him the desire to be conciliatory and courteous, there are only two ways to make him at least observe the forms of civility—namely, through incentive or fear. If he has ambition to progress and knows that he must follow instructions to do so, he will likely do his best. If he has the fear of losing his position for disobeying he will likely make a brave attempt to do what is wanted. If a company manager wants really to know how his patrons are dealt with, let him send a representative unknown to employees to his different offices to make such inquiries or complaints as are usually made by patrons or the public, and learn how they are treated or answered. Let the representative call up the offices on the telephone asking for information and learn what replies are given or what delays are met with. Some surprises will be in store for the manager who shows this amount of interest in his business. He will learn that he has some clerks who are wonders in diplomacy, and others who handle customers as if they were material to be "eaten up."

The Nature Of Service.

It too frequently happens among corporation employees that the words "serve" and "service" are not rightly understood. The utility company serves the people and consequently the company, its officers and employees are servants. Dignified service is honorable, and in no way degrading, unless the servant himself degrades it. Life is made up of service—all are servants in some respects, although perhaps masters in others. The motto on the coat of arms of the heir to the throne of England is, "I serve." The policeman on his beat, the judge on the bench and the governor in the capitol, all serve, and the President of the United States is the greatest servant of all, because he serves all the people.

If a servant in a house should become uncivil, inattentive, indifferent or discourteous to his master, would the master be pleased? Would he love that servant and say that he would be delighted to help him to the utmost? No, not likely! The master would probably say to himself "I will let that fellow go as soon as I can find someone decent to take his place." The relation between the utility company and the public is very similar. The public is the master and the company is the servant. The company exists by virtue of the franchise granted by the public. The public patronizes the company and from the public the company derives its income. The company is the servant and the public is the master. In the very nature of things, the servant must frequently ask the master for more favors—are they granted cheerfully or reluctantly? That depends upon how the servant has pleased the master. Favors asked

by companies often look formidable to those who do not understand; but with communities as with individuals, conciliation may be better than logic—they may often be persuaded when they cannot be convinced.

The public is the people, but whom do the people know as the company? Not the bondholders, stockholders, or directors—not the president, secretary or manager—just the employees who transact the company's business with the public. In all truth a company is known and judged by the men it keeps; at any rate, the public knows of no other way to determine whether a company is good, bad or indifferent—no other way to tell whether a company is worthy of confidence or entitled to distrust. If the confidence of the public is the greatest need of the public utility company, then the way to supply what is needed is to conciliate —not one department—but all through the organization; not once in a while, but all the time.

Courtesy Which Convinces.

It has now become a habit to lay stress on the word "courtesy" in referring to the relations between a utility company and the public, and it is a good habit. But there are degrees of courtesy—or rather it had better be stated, there is the imitation and the real article. There is the formal courtesy of the lip and manner, and there is the courtesy that flows from the heart. The former freezes and the latter warms—the one is seldom mistaken for the other. In other words, real civility and courtesy must come from within a man and not from without. Stripped of all verbiage, genuine courtesy is the "doing unto others as you would others do unto you." But courtesy is not all that is required to obtain confidence; there must be conciliation. This word expresses a combination of the attributes which compel confidence—namely, consideration, alertness, sympathy, attention and courtesy.

The paramount question is, how to spread the gospel of conciliation among company employees so that they may be permeated with the knowledge of what the word stands for, and its importance to them and the organization of which they are a part. Connected with every up-to-date electric company, there is a New Business Department, and it is a notable fact that the experienced salesmen attached thereto do not require to have the word explained to them. To use a colloquialism, conciliation is the middle name of every successful salesman. They have learned that there can be no success in their work without courteous cheerfulness. They know that conciliation makes friends, and friends make business for the salesman. Now, if the salesman has learned how to spell conciliation, what has kept the cashier, order clerk, and other office employees dealing directly with the public, so backward in their lesson? Because the cashier or order clerk is behind a counter in an office, and the customers go

to him to do business, is he any better than the salesman who must go out and seek the customer? Is there any reason why an office man should adopt an air of superiority and talk to the customer impatiently, uncivilly or condescendingly? There is no reason—but even today there are some office clerks so blind that they cannot or will not see the bad light in which they place the company which is paying their salaries, because of lofty indifference and careless discourtesy to the company's patrons.

Selecting Representatives.

The principal points of contact between a company and the public should be guarded by employees who have been carefuly selected for the position they have to fill. The manager will find that for the good of his company and its standing with the public, he cannot give too much thought to this important matter. The question of salary should not be allowed to interfere with getting good men for such work—or of keeping good men at it. Employees of the wrong stamp are dear at any price. Men who are forgetful, moody, grouchy or dyspeptic should be kept in the background and only such men as are cheerful, alert and considerate should be in the forefront in whatever place or through whatever medium the company may transact its business with its consumers and the public.

Some men are born with a natural desire to win friends by conciliation—a few men may have this quality developed in them by education, and others could never acquire it by any possible way. Most electric companies hold regular or occasional meetings of their employees, and it is suggested that at these meetings those responsible for proper public relations should give a series of "little lessons on conciliation." Employees might be called upon to demonstrate how customers should be handled under different conditions. At each meeting one department should show by actual demonstration the ideal way of pleasing the public from its standpoint. In their turn those in charge of office work, collection department, sales department, trouble department, service department, and telephone exchange should show to others in the company how the work can be done in a manner which will please and make friends. The manager should be on hand to criticize, suggest and point out the value of the right way and the injury resulting from following the wrong way. Such a program would impress employees with the absolute necessity of conciliation, and will produce good results, where circular letters of instruction would not avail.

The Extent Of Conciliation.

There is an attitude of conciliation which almost every man can assume if he is personally desirous of impressing another to gain a wished-for end. It expresses a desire to please which is clearly visible in the eyes, in the features, in the gestures and in the tone of

voice which cannot be misunderstood. This attitude of conciliation is visible not only in personal contact, but may be traced in the wording of letters, and felt in conversations over the telephone. If a man can effectually assume this attitude in personal matters, he surely can also assume it when transacting business for the company which pays for his services. It is the part of the prudent man to conciliate the minds of others and turn them to his own advantage. It is the part of a wise man to conciliate others and turn them to the advantage of the company with which he may be connected and to whom he looks for his future advancement.

Some men think they have done their full duty towards the policy of conciliation if they "meet the customer half way." Some men go a little further and say. "Give the customer the benefit of the doubt," believing that should be sufficient to please and satisfy. But no! perhaps both classes of men have stopped too soon, for in a complaint or controversy, the real attitude of conciliation assumes that "the customer is always right." Before such an attitude, complaints are forgotten, troubles vanish, and opposition fades away. The attitude of conciliation does not mean a loss of self-respect or the relinquishing of any rights. On the contrary, the implied consideration for the feelings and rights of others adds dignity to a position and costs absolutely nothing.

Representatives of a corporation, in its defense will sometimes state that it is only an aggregation of individuals, and that the corporation should not be blamed for individual transgressions. What is the public but a greater aggregation of individuals who like their individuality recognized?

The corporation whose employees consistently practice the Art of Conciliation when coming in contact with its patrons will realize some day that, having pleased the individuals, it has finally won the much desired confidence of the public.

—A.G.A. Monthly.

Instrument Don'ts

THE following series of "Don'ts" compiled from an old bulletin issued by the Keystone Instrument Company, suggests some important precautions to be observed in the handling and use of switchboard instruments. These may well be read in conjunction with Mr. Borden's article in the March issue of the Hydro Bulletin.

DON'T mount instruments 8 feet above the floor line and expect to be able to read them unless you are prepared to furnish switchboard attendants 8 feet high. Eight-foot attendants are scarce and expensive.

DON'T place an instrument on top of an excited dynamo or motor. You will find a strong attachment between them and the instrument will resent the rupture of relations and become erratic in its performance. Instruments are very human in this respect.

DON'T attempt to club an instrument into subjection. Modern instruments can be depended upon to indicate without the necessity of external persuasion.

DON'T mount instruments topside down unless you are prepared to stand on your head when taking readings. This upside-down business is liable to produce internal disorders.

DON'T drop an instrument and then tell the maker you didn't. He may not know as much as you, but he knows a little. Possibly you don't care for his opinion, but a good opinion never did anyone any harm. Honesty pays, even if it is expensive.

DON'T overload an instrument and expect it to submit without protest. Every instrument has a pointer which shows its load limit. What a pity that some men are not similarly equipped!

DON'T be afraid to tell an instrument-maker what you want to measure and how you would like to do it. His suggestions may save you money, and will certainly lead to a better mutual understanding.

DON'T break the seals of an instrument just to see the wheels go 'round, and then expect the maker to assume responsibility for its performance. Seals are provided not only to protect the maker but also to protect the user.

DON'T set up a switchboard so it can vibrate continuously and expect the instruments to stand for it. Vibration causes friction, friction causes heat and heat causes a disinclination for steady, accurate work.

DON'T ship a switchboard with instruments attached. If you have ever tried travelling in a freight car on a marble couch you will understand why. A small amount of paper and excelsior with a berth in an express car saves most of the tiring effects of travel.

DON'T chisel out holes in the switchboard or rivet up the frame after the instruments are attached. If you do, you are almost certain to pierce a few jewels.

DON'T make a loop of your bus bars or risers and then mount an instrument within that loop. The field set up by such a loop worries an instrument and disturbs its natural truthfulness.

DON'T be careless. Jewels and pivots are essential parts of instruments and should be treated with some care and respect. Note the packing advice which accompanies each instrument. It is the result of experience and is worthy of consideration. The employment of a reasonable amount of care in mounting, connecting, handling and shipping instruments will pay you as well as us. As a popular advertiser says, "A trial will convince."

DON'T forget to connect an instrument into circuit, and then

claim it will not read. Connections should be made by means of the binding posts which are provided for that particular purpose.

DON'T connect a shunted type of ammeter in circuit without the proper shunt. The instrument requires a drop, but a drop too much may be injurious.

DON'T attempt to read an instrument merely by the distance of the pointer from zero. All self-respecting instruments are provided with scales and numbered divisions. It is considered good practice to make use of the scales.

DON'T try to polish a plated instrument case with sand soap or emery unless you are hunting a daily job. Plated surfaces are lacquered just to save you the trouble of polishing.

DON'T blame the instruments because your plant does not work satisfactorily. The instruments are intended to indicate trouble, not to remove it. The moral is: Look for the trouble and the instruments will tell you when you have found and remedied it.

DON'T allow contacts to become loose, dirty or greasy. Clean them thoroughly at the start and set them up tight. This will save a lot of trouble.

DON'T get mad. There is nothing personal in this. It is simply a brief list of our trouble with the other fellow. If, perchance you have been guilty on one or more counts, take our reminder as good naturedly as we have intended it. Remember there are a lot of you and only one of us. We need you all the time and you need us occasionally, so why not meet together and discuss our mutual interests, without losing our respective dispositions.

Super-Experience

By MARIUS LOGAN.

UP to a few moons ago we tightened the tickler coupling and fed the juice back to the grid for a re-supply of vitamines. If we shoved the old coil too far the juice fermented and the jazz got groggy.

One night our old friend Armstrong took a look at the sensitizing circuit and commenced to show signs of extreme agitation. Three nights later a radio store was minus a 1250 and a 1500 honeycomb coil. So much for the history of things.

Personally we weren't stuck on this new do-dinkus, but we were inquisitive enough to try and find out what lay beyond the 60° coupling on our tickler, so we decided to give it a trial. After much argument, the one-tube type was chosen. Since only one tube was available, the argument was un-

necessary, but we are men of theory and very seldom delve into the practical side of radio. To be truthful, excellent results have been obtained in our "laboratory" without a single piece of apparatus —aside from two "mouth pieces."

Well, to resume, with one tube, eight condensers, two pairs of phones, a variocoupler, an inductance wound on a whiskey bottle; 110 volts D.C. for the "B" and a pound of bell wire, we made a beautiful puzzle worthy of Einstein's mentality. Each using two hands and a foot, we proceeded to tune. Changes of inductance and capacity at one end of the table were relayed to the other end by wireless, where corresponding changes manifested themselves.

The results were tremendous—the silence appalling. After five hours of tinkering we discovered that our oscillatory circuit was shorted. The short was discontinued. Lord, what a mistake! The variation frequency made itself evident somewhere between four and five thousand. Many handshakes. Seven hours later the four to five thousand started to take effect. The mental complex was ghastly. Squealing, squealing everywhere, but not a single sig.

The family had already left. We were going fast. We shut the hellish thing off. The variation frequency continued; life seemed hopeless. Bloomingdales loomed through the horror until I—I had the brains to start reading Coue's auto-suggestion. I formed a philosophy. The now tottering brain of my compatriot was saved by my repeating—second by second in every way the variation frequency is getting lesser and lesser. Lo! It disappeared.

Five coffees and a cheese sandwich later we regained our nerve. The "super" was duly started perc'ing again. This time we raised the variation frequency to "about that".

After many struggles and knob turnings, something commenced to buzz, howl and squeal. "What do you suppose that is?" said my compatriot. "I'll bite," said I. "What is it?" Well, you'd be surprised. It was station XYZ as sure as blazes. The Hicktown Symphony Orchestra was playing "Carry me Back to Old Virginney," accompanied by the carrier wave. Sacre blue, it worked.

After the first "howling" success the process of elimination took place. Slowly but surely condensers evaporated, and incidentally the necessity of using our feet. With each piece of apparatus discarded the results were better, which goes to prove that simplicity is the keynote of efficiency—even with the "super."

When the aerial and ground were done away with, it was feared that we might end up with a "super" consisting of nothing but two crossed wires, obtaining the supereffect of course from the thermal action.

The super as is and as was are two different animals. With but two condensers, a variometer and the soup coils, the old broadcasters came in like a ton of C.W. transformers. With expressions of contentment we sit two rooms up from the "lab" and listen to the latest dope on how to grow a golf links or some other appropriate subject. Heaven may be found down on 200. As Lincoln said, "Don't it beat hell!"

—Radio News.

Another Story-Teller

Him we've had with us for ages, . .
(Great his name on hist'ry's pages),
He's the man who always fibs about the size of fish he's caught!
And the golfer who'll embellish
Tales about his play with relish,
Well, I think we're all acquainted with that chappie, are we not?

Now these two they have a brother,
And he's worse than any other,
So much so you'd dearly love to drop him off some awful height!
He's the chap who goes round telling—
With a head that's plainly swelling—
How he managed to get Sweden on his radio last night!

"Oh, I'm feeling pretty perky,
Heard last night as far as Turkey."
Oh, the smugness of the fellow, and the casual way he said it!
Yet you know as sure as dying
That the silly beggar's lying,
That he never listened in on any place beyond Port Credit!

Oft his set was made from laces,
Carpet tacks and packing cases,
Bits of this and bits of that and odds and ends from everywhere!
None the less, with great aplomb, he
Will inform you, from Miami
He just got a message clear as any that he got elsewhere!

—The Evening Telegram.

Emergency Communication by Guided Radio Telephone

By F. K. D'ALTON.

Assistant Laboratory Engineer, H. E. P. C. of Ontario.

A RELIABLE method of communication of intelligence is one essential in any operation where two or more persons are participating. When these parties are within hearing distance or within sight of each other, the human senses will serve to dispatch and receive messages, by voice or visual signal respectively; but when the persons co-operating are widely separated, a long distance system of communication must be adopted.

The more urgent the messages, the more reliable must be the system of communication. It will be realized that a power transmission system, which depends for its smooth operation upon the messages sent from station to station, must have a dependable method of sending and receiving these messages. The physical telephone is satisfactory until interrupted by induction, an open circuit or other troubles in the lines, at which time some other method must be used. For communication under such conditions, which we may call "Emergency Communication", radio equipment has been installed in the generating and transformer stations of many power systems.

In the following paragraphs we shall compare briefly the methods of communication by radio with the land line systems and also give a description of the guided radio equipment recently installed for emergency use on the Niagara System of the Commission.

Radio vs. Wire Systems.

It will be remembered that one of the earlier methods for communicating at a distance was the land telegraph, signalling being accom-

plished by means of a code. To be familiar with the codes then used required special training on the part of all operators but this tended to secrecy as untrained persons could not interpret the signals. When the telegraph was followed by the telephone, special training was unnecessary, and the development of communication systems advanced rapidly.

These systems, however, require that a continuous metallic connection between the stations be maintained at all times: the equipment becomes inoperative immediately the circuit is opened at any point.

The radio telegraph and radio telephone have now followed the land wire systems of communication and exhibit several advantages and a few disadvantages in comparison with the latter. For example, radio systems do not require metallic connection between transmitter and receiver and, therefore, are not affected by open circuits developing in lines. They are not secret systems, however, as all messages sent may be received by any person who cares to tune to the radiated waves. On the other hand, the land system may be considered secret, messages being delivered to the parties desired with only a few opportunities for others to listen.

For the broadcasting of information, the radio system is almost ideal. Such systems, however, are affected by weather conditions and at certain times cannot be used with certainty of the messages reaching their destination.

Radio Methods.

Radio, considered as a method of communication by means of electric currents of high frequency, may be used in three ways,—

(1) Straight Radio—where the energy is radiated from an aerial wire and is propagated through the ether in all directions, being receivable at any point within the range of the equipment.

(2) Guided Radio—where the energy is radiated from an aerial in the proximity of a power transmission line, a large part of this energy being absorbed by the line, conducted along the line and finally re-radiated. Another aerial near the line will collect some of the energy and lead it to an ordinary radio receiver.

(3) Carrier-current communication—where the high frequency output of a radio transmitter is passed through small. condensers to telephone lines, and along these lines to a radio receiver at the distant end.

The energy required for communication over a given distance by any of the methods in which radio frequency energy is used is much greater than that required in the land line systems. If the radio waves be guided by a power line, however, the energy required per mile is less than in straight radio communication and the secrecy of the system is greater as there is not as much free radiation of energy. To cover a given distance by

guided radio, equipment of comparatively low power may be used with greater assurance of the message being received correctly than by straight radio. This system is independent of all telephone lines and, we believe, is operative even if all power lines be fallen down. We have not yet had occasion to operate under this condition, however, and therefore are not certain how the signal strength would compare with that obtained under normal operation with all lines in service.

Development of Guided Radio Equipment.

On account of the higher efficiency of the guided radio system and in order to provide a means of communication which would be independent of the land telephone lines, the Commission decided to install suitable guided radio telephone equipment at all high tension transformer stations on the Niagara System, and thus to make use of the 110,000 volt power lines for communication as well as for power transmission. These radio telephone sets were to be transferable to the physical telephone lines so that alternative channels would be available and communication would be fairly sure in the event of trouble on either the power or the telephone lines, or even in case of interruptions on both systems.

The development and installation of this equipment was undertaken by the Laboratories and considerable development work has been done in order to bring the equipment to the state of highest efficiency.

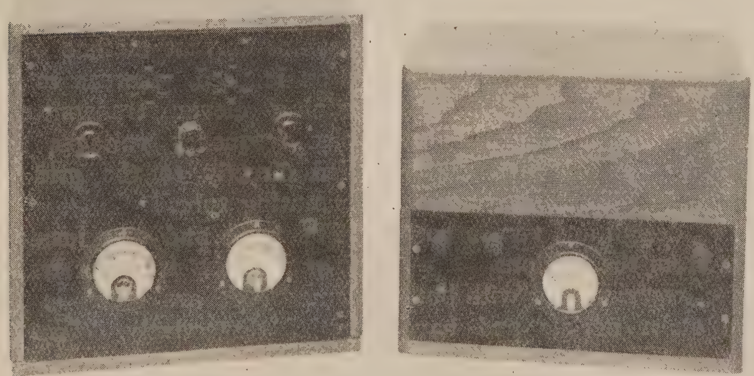

Fig. 1.

Front View—Two Tube Radio Telephone Transmitter.

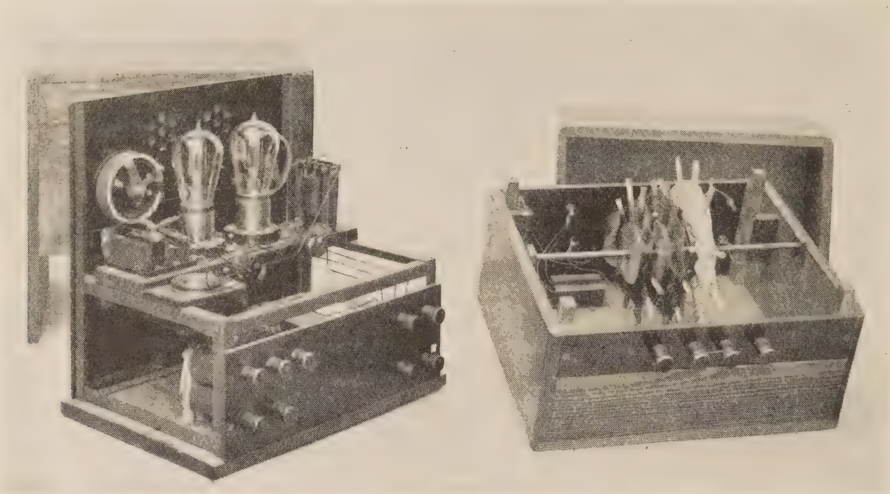

Fig. 2.

Rear and Internal View—Two Tube Radiophone Transmitter.

(*a*) *Aerials.*

The aerials at all stations have been erected between the steel towers which support the power lines. At many stations the ground wire above the power lines has been insulated and used as an aerial; at other stations the aerial wires have been strung below the power lines.

Some of our aerials are of the inverted "L" type running in one direction only but able to communicate in both directions, others are the "T" design and run in both directions from the stations.

We have experimented with both long and short aerials and have found that a "T" aerial of one conductor approximately 900 ft. and located about ten ft. above the power lines gives the most satisfactory, consistent results.

For grounding our sets connection is made to the ground bus of the transformer station.

(*b*) *Transmitters.*

We have two types of transmitters in operation on our Niagara System.

In four of these transmitters a constant current method of modulation is used, whereas in the remaining eleven transmitters the voice frequency voltages are applied directly to the grid of the generating tube.

The front and rear inside views of one of the transmitters of the former type are given in Figs. 1 and 2 respectively. Two power tubes are used in each transmitter and these together with necessary control rheostats and the noise filter are contained in one cabinet. The inductance coils, by means of which adjustment for wave length

is accomplished, are in a separate cabinet.

Fig. 3 gives a front view of one of the transmitters using grid control. This transmitter has only one power tube and is quite simple in operation but is much more critical in adjustment than the first type described. The wiring of this type of transmitter is shown in Fig. 4, the noise filter being shown as separate since it is not contained in the main transmitter cabinet but is in a small cabinet by itself.

(*c*) *Receivers.*

Our receivers also are of the type used for straight radio communication. Two three-element vacuum tubes are used, one for detection and the other for audio frequency amplification.

Figs. 5 and 6 respectively show the front and rear internal views of these receivers, the latter showing the tubes, amplifying transformer, honeycomb inductance coils and variable condensers in their relative positions; Fig. 7 is

Fig. 3.

Single Tube Radiophone Transmitter.

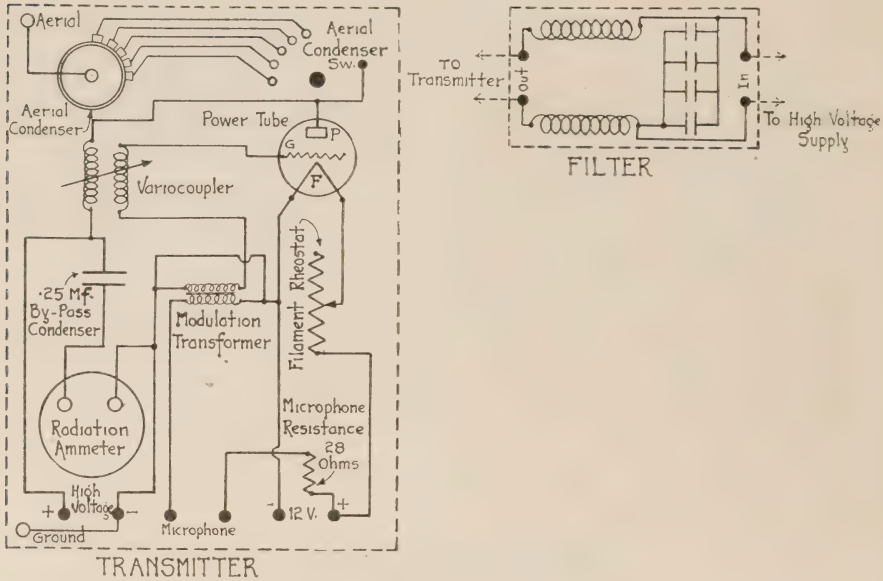

Fig. 4.
Internal Connections—Single Tube Radiophone Transmitter and Audio Frequency Filter.

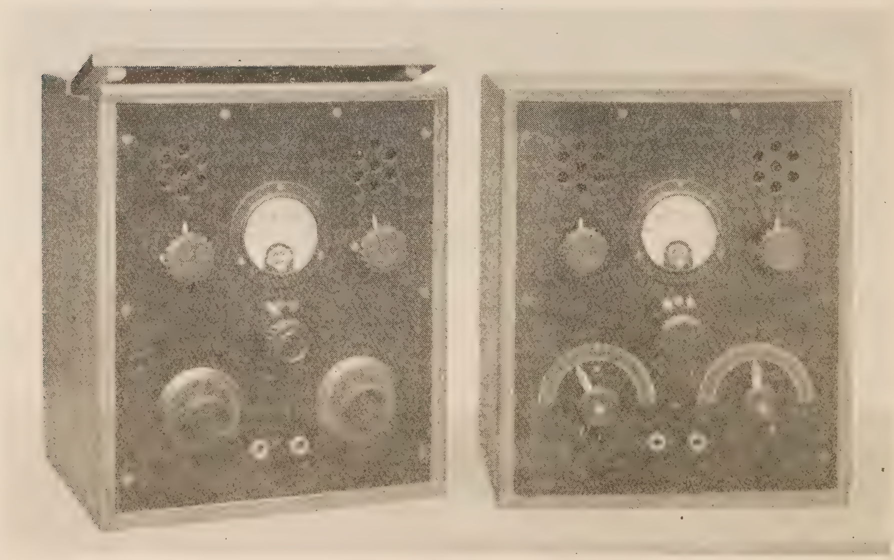

Fig. 5.
Front View--Standard Radio Receivers. Niagara System.

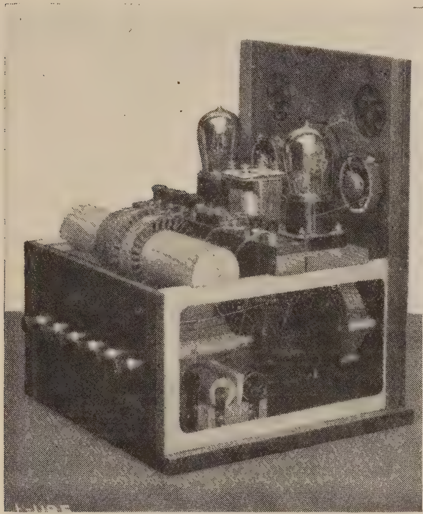

Fig. 6.
Rear and Internal View—
Standard Radio Receivers.

the wiring diagram.

These receivers have been designed to give the highest efficiency of reception at the one wave length on which all of our guided wave stations operate, namely, 1,570 meters. Within their range, however, they include the wave length of 2,500 meters on which time signals are sent from the United States Weather Bureau through the spark transmitting station at Arlington, Va. Each station receives these signals independently of all other transformer stations on the system, and thus each has an excellent means for the checking and adjustment of the station chronometer.

(*d*) *Operation.*

Each installation consists of a suitable guided wave aerial, one transmitter and one receiver, with the necessary high voltage generator, storage battery, switches and other parts connected as shown in Fig. 8. These connections are practically the same whichever type of transmitter be used.

Three switches are provided, namely:—

No. 1. To ground the aerial when not in use.
No. 2. To select between aerial and telephone lines for operation.
No. 3. The "transmit-receive" switch.

In starting a test or conversation, the operator closes switch No. 2 on one side or the other—which side depending upon whether he is to use the aerial or the telephone lines. When he is using the aerial, he also opens switch No. 1. He then throws switch No. 3 to the left, tunes and listens; or to the right and speaks. In carrying on conversation switch No. 3 is alternately thrown to the right and to the left. When the communication is finished, switch No. 1 is closed and switches No. 2 and No. 3 are left open.

Interruption of Power Supply.

Since this radio equipment is installed for use in cases of emergency—for instance, while there is a power interruption—it is essential that the sets be not dependent upon the alternating current supply: they must be run from a source of power which is not subject to interruptions. Storage batteries are therefore used for driving the high voltage generators as well as for lighting the fila-

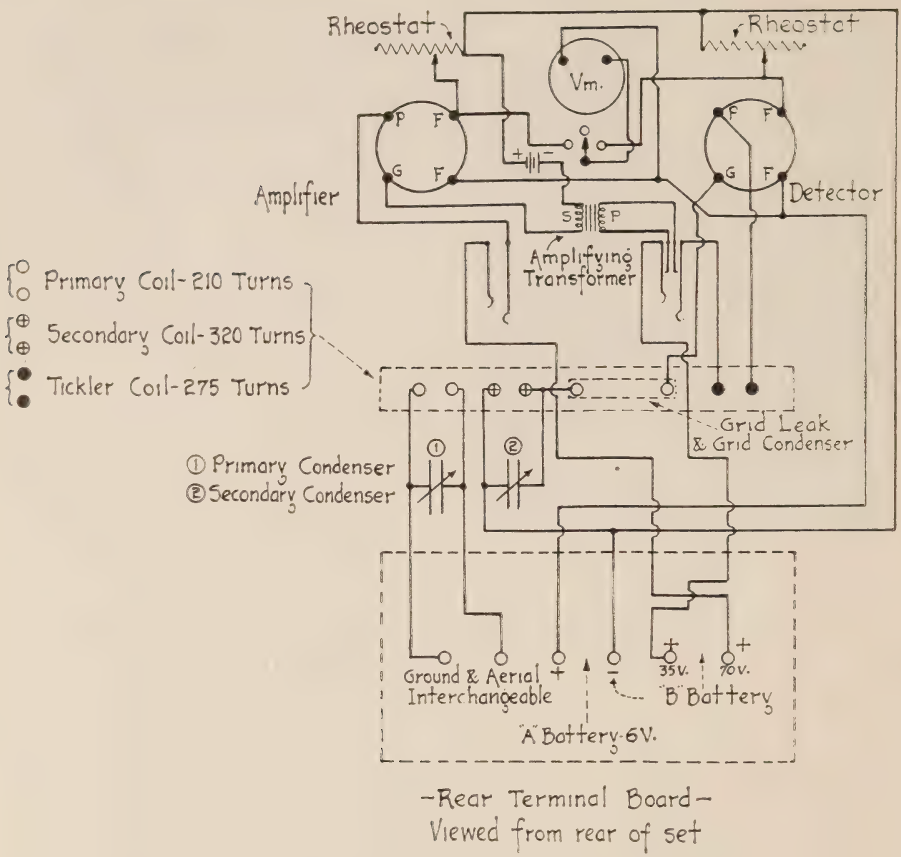

Fig. 7.

Wiring Diagram—Standard Radio Receiver,

ments of the power tubes.

Where a transformer station is equipped with a 110 volt storage battery, we obtain the high voltage for the plate circuit of the transmitters by means of a motor generator set, the motor of which operates directly from the battery, the separately excited generator giving from 400—1000 volts. Such motor generator sets are in use at Niagara, Toronto, Dundas, London, Kent, Essex, Stratford, Preston, and Cooksville.

At several of our stations, however, we have not 110 volt storage batteries and to obtain the high voltage, we use a small dynamotor driven from the transmitter filament battery. In all of these cases we use rectifiers for charging the batteries. The following stations are operated in this way,—St. Thomas, St. Mary's, Kitchener, Guelph, Woodstock and Brant. Whichever type of machine is installed, however, our standard connections, Fig. 8, take care of its operation.

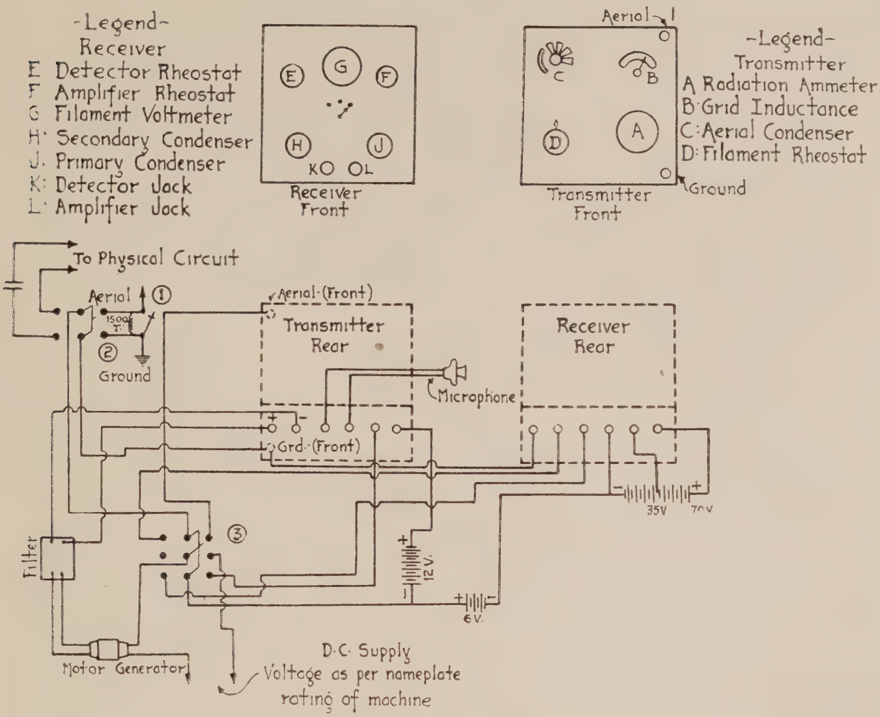

Fig. 8.

Connections—Single Tube Transmitter and Standard Receiver.

Power or Electrical Appliances Recommended Size.

Range and Sensitivity of Equipment.

The output power rating of our transmitters is about five watts, and our receivers have only one stage of audio frequency amplification. For straight radio communication on this wave length we would expect the range on a summer day to be about six miles. With these sets, however, operating on the guided radio aerials, we have reached a distance of 195 miles over our power lines in daylight.

It should not be thought that satisfactory communication could be established regularly over this distance as the weather conditions affect guided radio systems in much the same manner as straight radio communication, and this maximum was obtained under quite favorable circumstances.

Our range would be much greater than this were it not that a very large absorption of power takes place when an attempt is made to pass a transformer station. The condenser bushings of the high tension oil switches apparently form an effective ground for radio frequency currents and we believe that the energy is lost by being led to ground through these condensers. Where a transformer station taps onto a line, much the same

effect is noticed.

In communicating between adjacent stations on any part of the system, however, a very high degree of sensitivity is obtained. Whispered messages may be received over the unbroken and untapped sections of the transmission line, as for example,—from Dundas to Toronto, Niagara, Guelph or Brant Stations,—distances varying from twenty-five to fifty miles.

When used on the physical telephone lines, the speech is clearer and much louder than with the ordinary telephone. The radio sets are not then as much affected by the various noises to which telephone lines are subject.

Interference.

We do experience a certain amount of interference, however, when operating on the aerials. Our aerials are close to power lines, and the charging of arresters, flashing of insulators, or any discharges in transformers, motors, or other equipment connected either directly to the high tension lines or to the low tension distribution system from the transformers connected to these lines, seriously interfere with the operation of the radio equipment. This is to be expected since the surges caused by such flashing are of much the same nature as the radio waves which the receivers are designed to detect.

High voltages are induced on all guided wave aerials, due to their proximity to the high tension lines, but as the frequency of these voltages is 25 cycles per second and therefore below the range of audibility, we do not experience much interference from this source. The charges are drained to ground through a honey comb coil having a long natural wave length.

At times considerable static interference, similar to that known as "summer static" on straight radio equipment, is found in the receivers. The coupling of the inductance coils is then loosened, and though not completely prevented, the interference is much reduced, permitting messages to be received with certainty.

Conclusions.

Guided radio communication is now being given a thorough test on the Niagara System and the equipment installed has fulfilled all requirements in several cases of power and telephone line interruptions on various parts of the system.

A means of calling an operator to the radio set would be a desirable addition but in order to have a sufficiently sensitive calling system, a number of tubes must be kept burning continuously in each receiver. The maintenance of the equipment would thus be considerably higher and more attention would be necessary in the charging of batteries and replacement of tubes.

The installation of high power straight radio equipment is contemplated at several of the more important transformer stations to provide a means of broadcasting messages to stations as another system of emergency communication.

HYDRO NEWS ITEMS

Central Ontario System

A severe thunderstorm accompanied by extremely heavy rainfall occurred on June 5th., when the generators at Healey Falls station and Auburn station were damaged. The motor generator sets operating the Peterborough Radial Railway were also put out of service for several hours.

* * *

Contracts for a supply of service to Warkworth have been executed. Sufficient contracts have been obtained to ensure successful operation.

* * *

The several factories operated by the Dominion Canners are increasing their installation.

* * *

Extensive improvements to the local distribution system in Tweed are under consideration.

* * *

Eugenia System

On May 30th., representatives of the Municipal Engineering, Operating and Auditing Departments, met by appointment the representatives of the municipalities making up the Eugenia System at Owen Sound. There were about seventy-five representatives present and an excellent luncheon was provided by the Owen Sound Commission, after which the representatives of the Commission explained in detail the factors entering into the operation of the System and the financial results in each municipality during 1922, as well as the proposal to install an additional pipe line at the Eugenia Development and install a tie line to the Niagara System with the necessary frequency changing equipment to enable the Commission to meet the constantly increasing power demand on the System and operate the Eugenia plant with maximum capacity on a peak load basis. The meeting was harmonious and the municipal representatives well pleased with the result of operation and enthusiastic as to the future. Resolutions were unanimously passed, approving of the manner in which the Commission had operated the System in the past and of the plans proposed for increasing the supply of power in the future, and a vote of thanks was passed to the representatives of the Commission for the explanations in regard to financial operation and to the operators of the System for the manner in which the supply of power had been kept available during the long trying period of low water supply.

Niagara System

Work is now proceeding in connection with the changing of insulators on the Stratford to Goderich 26,000 volt line. The new type of insulator is much superior to the type being replaced.

* * *

The 26,000 volt circuit supplying Palmerston is being carried back to the Stratford High Tension Station in order to give better operating conditions.

* * *

An automatic telephone system is being installed at Niagara Falls connecting all generating and transforming stations. The connections between stations are underground.

* * *

The following changes have been completed, or at the present time are under way, in connection with the Commission's 110,000 volt stations.

Plans are being prepared for the construction of a new high tension station in the north-west part of the City of Toronto, at which two banks of outdoor type transformers will be installed, each having a capacity of 15,000 kv-a.

The transformer capacity at the Davenport terminal station (formerly of the Toronto Power Company) is being increased by two outdoor banks of 15,000 kv-a. each.

The capacity of the Commission's Strachan Avenue transformer station in Toronto is being increased by one bank of outdoor type transformers of 15,000 kv-a. capacity. New high tension breakers have been installed on the two incoming lines at Strachan Avenue Station.

Two banks each having a capacity of 15,000 kv-a. have been installed in the Commission's Essex transformer station. These two banks replace the original bank of 3-2500 kv-a. transformers.

A second bank, consisting of 3-1250 kv-a. transformers, has recently been installed in the Stratford transformer station.

A bank of 1250 kv-a. transformers at Woodstock transformer station has recently been replaced by transformers having a capacity of 2500 kv-a. each.

Parts of the new 15,000 kv-a. generator replacing one of those destroyed at the time of the accident to the Ontario Power Co. plant in May 1922 have been shipped, and it is expected that this machine will be in operation during the Fall of the present year.

Work is proceeding with extensions to the Queenston generating station to accommodate the first of the three additional units now on order. It is expected the first unit will be in operation by the end of the present year.

Arrangements have been made to construct, during the present year, a tie line between the Niagara and Eugenia Systems. The tie-in will be made by constructing a line from Harriston to Mount Forest. The telephone lines of the Niagara and Eugenia Systems will also be connected at this point.

A request has been received from the Village of Jarvis for rates for power service, and it is expected that power will be supplied to this Municipality during the present year.

* * *

Severn System

On Friday evening, May 25th., representatives of the Municipal Engineering and Auditing Departments of the Commission, met the Hydro Commissions and Members of the Councils of the Municipalities of Alliston, Tottenham and Beeton, in the Council Chamber of the last municipality, to discuss the operation of the Hydro Systems in these municipalities, and ways and means for increasing the load and extending the use of the service. The meeting was a most harmonious one, with the best of spirit and optimism. It is proposed to put on a campaign for new business. There are a large number of unwired houses in this district and the municipalities propose to assist in financing the cost of wiring and installing ranges by carrying the greater portion of the expense on the deferred payment plan, and arrangements to do this are now being completed.

* * *

St. Lawrence System

A valuation of the Distribution System of the Hawkesbury Electric Light and Power Company, Limited, in the Town of Hawkesbury is to be submitted to the Municipality of Hawkesbury in connection with the recent request from this Municipality for estimates on the supply of 1000 to 2000 H.P. from the St. Lawrence System.

* * *

A request has been received from the Council of Finch Township for estimates on the cost of service to rural residents in the Township, and also to have a representative attend public meetings to give information on the distribution of power in rural districts.

* * *

Additional extensions are being constructed to supply additional rural consumers in Williamstown and South Lancaster, in the Martintown Rural Power District.

* * *

Rideau System

Certain improvements to the storage dams on the Mississippi River are now being undertaken by the Mississippi River Improvement Company. Partial reconstruction of the dam at Cross Lake will allow for more efficient drainage of this lake. Legislation is being sought for a permanent dam on the Mazinaw Lake, and in the meantime a temporary dam is to be erected. In view of the increasing load on the Rideau System, it is vital that these improvements be carried through without delay.

* * *

The Grenville Crushed Rock Company is now in full operation, and is taking its full load of about 600 h.p.

* * *

An additional load in Kemptville has been contracted for by the Dominion Tile Company.

THE BULLETIN

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CONTENTS

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The Orillia Convention

The Association of Municipal Electrical Utilities held another Convention, reports of which are to be found in this issue. All previous summer conventions have been held at Niagara Falls, which gave the delegates an opportunity of viewing the Queenston-Chippawa development during its construction. This work having been finally placed in operation, it was thought fitting to have a change of scene, and accordingly the Association availed itself of an invitation from the town of Orillia to hold this summer's convention there.

The town of Orillia holds the distinction of being a pioneer in the generation and transmission of hydro-electrical energy under municipal control, and it was therefore quite fitting that the Association should hold its convention there. The day spent in visiting the generating plant, in spite of the fact that the weather was not the most desirable for boat travelling, was a most agreeable event, and everyone was most favorably impressed.

One cannot say anything else than that the convention was most successful, and that during the three days there were no dull moments. The Orillia Water, Light & Power Commission and especially its Secretary, Mr. F. Gover, and Engineer R. H. Starr, were untiring in their efforts and cannot be given anything but the highest praise for the manner in which the plans for entertainment were taken care of.

The President's Address

By A. T. HICKS

I WANT to thank you for the honor conferred upon me by the election to the position of President. Since we have come here we have experienced the warm fellowship which inspires the members and which seems to have flourished at its best here in Orillia.

I believe that we are out to have a great convention. I trust that we will at all times throughout the several sessions keep in mind the responsibility we owe the Committees in preparing such a fine program. The program has been prepared with great care and with the earnest purpose of providing sufficient time for all needful discussion and of making this great gathering a source of mutual help and lasting inspiration.

May I here pay tribute to the loyalty, faith and unselfish—yes, in many instances, sacrificing—service of the chairman, Col. Sir Adam Beck and chief engineer, F. A. Gaby of the Hydro-Electric Power Commission of Ontario. It is inspiration to have a part in its administration, because wherever one looks in the progress of electricity he is met with the vision of practical men giving practical service to the ideal of more efficient service.

Few have earned such an enduring place in the esteem and affection of the members as the man who from the beginning of the association has been its secretary. We will never know our debt to S. R. A. Clement.

We have attempted in the preparation for this convention to limit the number of papers presented, in the hope, and expecting, that more time and consideration will be given to the discussion, and we trust the members will take advantage of the opportunity.

Before we start, I want to make a personal appeal,—I want to appeal for prompt attendance after the opening of our sessions and for constant and faithful attendance. We can make this convention a great success if we are here on time and stay through the sessions. I appeal to you for your support in this regard, because it will make for the easy handling of the Convention and assure that we get the best possible results.

Transformer Designing

By C. W. BAKER

Chief Engineer, Packard Electric Co. Limited, St. Catharines.

DESIGNING a transformer has been likened to making a lump of putty into a perfectly round ball:—pressing in a bump at one side causes some other portion to bulge out. So it is with a transformer design; if we put in more copper to reduce the copper loss, the length of the magnetic circuit will be increased in order to surround the greater amount of copper—costs for copper and iron go up—core loss goes up, exciting current goes up, and probably the reactance will be altered, and, of course, the efficiencies are changed and possibly the transformer will no longer fit into the tank that the designer intended to use.

The "Experience Method" of Design

Nearly all transformer designs are made by what we might call the "Experience Method"—that is—the designer by virtue of his experience visualizes the approximate dimensions of the transformer which will meet the capacity and guarantees under consideration.

We may start almost anywhere. Let us choose say the mould dimensions as a starting point. The insulation and assembly allowances will determine the cross-section of the core within the coil.

From this core area, the frequency, and the chosen magnetic density, is determined the volts per turn, and, of course, the number of turns in the high voltage and low voltage windings.

The allowable current density in the copper determines the size of the high voltage and low voltage conductors. The designer then arranges them on the mould with appropriate insulation, cooling duct and winding allowances. He may then determine the lengths, resistances and weights of copper required for the windings: also the copper loss.

The coil dimensions and appropriate insulation and clearance allowances determine the size of the "window" or "opening" in the core. The chosen magnetic density in the yoke determines its sectional area and he can now determine the weight of core:—core loss and exciting current; also the efficiencies, reactance and regulation.

If the guarantees are all met and he has not spent too much money for copper and iron, he may proceed to design the end frames, lead supports, tank and bushings.

If he has fallen outside any of the guarantees, he must press in the design at this point, letting it bulge out at some other point

where he has the best margin between the performance and the guarantees.

Systematic Methods of Design

These methods of design are based on equations corelating the effects that a change in any dimension will have on the other dimensions and properties of the transformer. They start with the current densities in the windings, insulation allowances, magnetic density in the portion of the core within the coils, the estimated cost per pound of copper and iron in the transformer, including the labor to put it there, and the amount of waste material. This purports to give the cheapest design for the conditions chosen at the start, i.e. given current densities, magnetic densities, etc. They are excellent for estimating purposes or for a first design where there is no reference design available that is somewhat similar to the transformer desired.

These systems consider the transformer from the point of view of coils, core and insulation, but pay little or no attention to the effect on the cost of tank, fittings and oil required.

General Consideration

In general, a tall slim tank is less expensive, transformer and all considered, than a tank of more nearly cubical dimensions, since for the same contained volume a much larger tank surface is exposed to the air. Here the designer balances his saving in cost of tank and oil against a possible increase in the cost of the transformer.

In general, a single conductor has higher eddy current losses than the same sectional area made up of several strands. A number of small conductors cost more than one large conductor and require more handling. They also take up more room, and space is valuable. The designer pays in manufacturing cost in reducing eddy current losses by stranding the conductors.

In general, cores built of thinner laminations give lower eddy current losses than when thicker ones are used, but surface oxide and core plate enamel take up valuable space, reducing the space factor and increasing the actual magnetic density in each lamination. Thus his gain in eddy current loss by using thinner laminations is offset by an increase in hysteresis loss. Also the thinner laminations cost more per pound than the thicker ones.

The designer must also keep in mind the "personality" of the shop. For instance: in Power Transformers, for any given voltage, there is a capacity above which the design would be shell type and below which a core type design would be used. Core types are usually used where round wire is required in the high voltage winding. Shop "A" will run their core type designs to capacities considerably above this dividing line, while Shop "B" will build shell types much below the line, and each shop will find its own practice the most serviceable and the cheapest to manufacture.

This has been and still is the actual experience of two prominent Canadian transformer manufacturers.

Types of Distributing Transformers

There are four types of distributing transformers, the Shell, the Core, the Central Coil, and the Multiple Return Magnetic Path.

All the early distributing transformers were of the shell type design. As the coils are largely covered by the core and as cooling ducts in this type increase the length of the magnetic circuit, they were practically all superseded by the core type.

In the Core Type there is a large coil surface exposed to the oil and cooling ducts may be so arranged as not to increase the length of the magnetic circuit. This more efficient cooling of the copper gives far greater overload capacity than can be obtained in the Shell Type design. The majority of manufacturers are now using the Core Type designs for their lines of Distributing Transformers.

The Central Coil Design (with two return magnetic paths) is virtually the Shell Type design laid on its side with the core shortened so as to cover much less of the coil. This arrangement permits oil ducts to be placed in the ends of the coils giving efficient cooling without increasing the length of the magnetic circuit. Thus we have a combination of the better cooling of the core type with an approximation to the shorter magnetic path of the shell type. By increasing the sectional area of the outer legs of the core, the magnetic density is reduced, the core loss kept low and the exciting current is also low. These gains in performance are at the expense of an increase in the total weight of active material, which also means greater manufacturing costs.

In the multiple return magnetic path type, for the same weights of materials a still further reduction may be had in both the core loss and the exciting current, but these gains are at the expense of a more complicated design, more elaborate end frames, more expensive assembly, and greater difficulty of repairs. There is also a larger proportion of the coils covered by the core than in the other types.

In Canada and the United States four return magnetic paths are used surrounding rectangular coils. In Europe they carry the complication still farther, using circular coils and ten or twelve return magnetic paths. This almost completely encases the coils in iron, making proper ventilation of the coils difficult.

The Consumer and the Designer

In the days when lighting was practically the only commercial use for electricity and the generators were shut down shortly after midnight and not started again till dusk, high core losses were of little significance; copper was cheap and copper losses were kept low. Under these conditions the maximum efficiency of the transformer is at a

considerable overload, which, of course, was never reached for the art of loading transformers to the limit was not developed at that time; nor had high grade electrical sheet steel been developed.

As commercial uses for electricity developed, it became necessary to keep the circuits alive continuously and transformer core losses assumed a greater significance and the designer had to discard his former designs and make new ones to meet the new conditions.

Then electrical sheet steel of lower and lower losses was developed; each improvement in the steel calling for new designs to meet the increasing competition.

As urban systems grew larger it was found necessary to raise the voltage from 2200 to 2300, or 2400 volts. Again the designer had to meet the new conditions and develop two or three lines of transformers where one line was sufficient before.

Now the rate maker steps in and his influence appears in transformer designs. He now charges according to "demand" with a power factor clause containing penalties for low power factor. This stimulated a demand for transformers with very low exciting currents. This demand was greatly aggravated by attempts to operate 2200 volt transformers on 2300, or 2400 volt systems, which, of course, greatly increased their exciting currents, especially so on 25 cycle systems. To meet this demand designers are turning more and more to the central coil type.

To economize on poles a demand has arisen for lighter transformers; also that the center of mass of the transformer shall lie closer to the pole. The reduction in weight was largely accomplished by the development of the all steel tank. By squeezing the designs in one direction and permitting them to bulge in the other two directions, the center of mass has been brought much closer to the pole than in earlier designs.

To obtain low exciting currents the designer endeavours to have (a) his magnetic flux path as short as possible, (b) a large number of turns in the windings, to keep the magnet density low; also for the reason that a small current and many turns will produce a large magnetizing force, (c) the joints in the magnetic circuit should be, as far as possible, where the magnetic density is lowest, and (d) careful selection of his sheet steel.

To accomplish (a) shortest magnetic path:—the designer thinks of a square "window" but this will mean so much material in the yokes as to be prohibitive. It also reduces the length of the magnetic leakage flux paths, thus increasing the reactance beyond limits. It will also give a short fat transformer which adds to the cost of the tank and oil and throws the center of weight too far from the hangers.

To accomplish (b) large number of turns—he must make the "window" tall to reduce the length of conductor in order to keep the copper loss and reactance within bounds.

To accomplish (c) low magnetic density in the joints—he is turning

to the central coil type where there is but a short length of core at the higher magnetic density, i.e., the portion that lies within the coil: the rest of the circuit being of lower magnetic density. But this type takes more material for the same efficiencies than does the core type.

Thus the designer is constantly balancing a gain in one direction against a loss in some other direction, weighting his judgment with the demands of the purchaser, for "the man who pays the piper is the man who calls the tune".

For a time urban systems were buying larger and larger sizes of Distributing Transformers. They are now standardizing as far as possible on one or two sizes, which they buy in large numbers at very close prices. This standardization is of great benefit to all concerned.

The Hydro-Electric Power Commission and the Canadian Engineering Standards Association have done much excellent work in standardizing voltages, taps, name plates, grounding screws, lengths of leads and polarity. This work greatly facilitates service from the manufacturer to the distributers of power and on to the power consumers.

There is, of course, always the danger of carrying standardization too far into detail, and thus defeating its own ends by tying the hands of progress and development.

Discussion

Mr. M. J. McHenry, Walkerville: We are all interested in transformers, particularly in the pole type of transformer for distribution work. In the last few years most of the Hydro municipalities or a large number of them have been experiencing difficulties arising from the fact that we have had to increase the capacity of our distribution transformers very greatly on account of the increased domestic demand due to electric ranges, water heaters and equipment of this type. As a result of this, the question of exciting current becomes one which we cannot overlook. In our own particular instance, I think that we are in as bad a position as anybody with the question of exciting current, for the reason that our peak is created by an industrial power load, and our range load does not occur at the same time as the industrial power peak. As a result of that we have at the time of our peak a large capacity in distribution transformers riding on the line at light load, and if the exciting current is high, as it is in some of the older transformers we feel the result in the low power factor on the peak.

As Mr. Baker has brought out, the manufacturers' side of the question has to be taken into consideration as well as that of the consumer, and it is possible in demanding too

low an exciting current, to obtain a transformer which bulges out in some other direction to the detriment of the general service. I think possibly it might be carried to the point of extremes where it would bulge out on the financial side, and we would possibly later feel the pinch when we are purchasing transformers, more than in any other place.

To my mind the question of distribution transformers is one which should be considered from a financial standpoint as well as from an engineering or technical standpoint. It is possible to ask for or specify transformers which will ultimately cost so much that the fixed charges carrying the investment will be more than the saving effected by the transformer owing to the specifications required.

There is at present, I think, in the Hydro-Electric Power Commission organization and amongst the municipalities generally a rather burning question as to the value of exciting current for transformers, and as to the voltage rating, whether transformers shall be wound for 2400 volts, irrespective of whether they are operated on 2200, 2300 or 2400 volt lines, and as a result we find that manufacturers are required to manufacture stock for two or three different ratings of transformers.

I feel that if this Association can do anything in the way of standardizing the voltage rating of transformers for Hydro service, that would effect a saving not only from our own standpoint, but from that of the manufacturers. Any saving we can effect for the manufacturer we should receive our share of when we come to purchase transformers.

I have considered for some time the question of 2400 volt transformers for distribution. We are now purchasing 2400 volt transformers for operation on 2200 volt lines, and hope that the results will be satisfactory. I believe that by purchasing transformers of this type we can get the low exciting current required, and not cause it to bulge too much in other directions. I may be wrong in my thought as to that and if I am wrong I will be glad to have my mistake pointed out by Mr. Baker. I think that is rather a ticklish problem at the present time. I would like to hear a discussion on the question of using 2400 volt transformers and also the value of exciting current we should have.

Mr. Jos. Showalter, Canadian Westinghouse Co.: This paper is certainly timely, because it would get the result which Mr. McHenry is seeking, I think. The transformer will cost according to the design, and the customer will pay the cost.

An electric lighting system was installed in a little town out in the West quite a few years ago, and the local newspaper attempted to tell its readers what various electrical terms meant, and what electrical apparatus was for. Among others, it made this statement, that the transformer is an apparatus which hangs on a post to grind the current into convenient size for consumption. And that is what it does.

A good transformer is a transformer which meets your requirements. It may be good for one

man's requirements and it may not suit another man's requirements, and he may say that it is no good.

I think Mr. Baker's paper will help this Association, so that they can adjust their requirements to a standard, and thereby reduce the cost to the manufacturer.

I would like to ask Mr. Baker if he would tell us what the result would be in using a transformer designed for 2400 volts, particularly for 25 cycle systems, on 2200, 2300 and 2400 volt lines.

Mr. Baker: If we design a transformer for 2400 volts, as suggested by Mr. Showalter, and use it on 2200 volts, as Mr. McHenry has suggested, the exciting current will go away down, your output will be reduced in the ratio of 24 to 22, that is, there will be that percentage less capacity in that transformer because you are not using your magnetic circuit up to the limits for which it was designed. While you have gained in exciting current, you have gained also in current losses quite appreciably. Your copper loss at the same current through the transformer will be exactly what it was before; and your kilowat capacity has dropped in the ratio of 24 to 22.

In operating in parallel with other transformers, that will make no difference. That transformer has a certain percentage reactance, and it will be close enough to make practically no difference in operating the other service transformer.

In service transformers you can still have an appreciable difference and still have good operating conditions. Mr. McHenry mentioned the desirability of standardizing on 2400 volt transformers. The fundamental thing to standardize on is 2400 volt conditions all over the country. If Toronto has 2400 volt conditions and some other city has 2200 volt conditions and we all build 2400 volt transformers, the man in the 2200 volt district is losing practically 10 per cent. in the capacity of his transformer.

If we could standardize on 2400 volt conditions all over the country we could all keep 2400 volt transformers in stock and ship them on a moment's notice, and at less average cost, because we would make them in larger quantities.

Mr. J. H Caster, H.E.P.C. of Ont.: Mr. President and Gentlemen: I have been trying for the last three or four years to get transformers which met the conditions. Mr. Showalter has said that a good transformer is one which works well. Unfortunately in the past buying a transformer has been something like buying eggs in a basket, some good and others not so good. Even if we have 2400 volts standard for Toronto, we have 2300 or 2350 volts other places.

I feel that we have not yet got this matter studied sufficiently. If Mr. McHenry will take the kv-a. on his chart and find what proportion of it is in the transformers, and what proportion in motors, he will see that a considerable saving would be made if he would scrap all his old transformers and get good ones. In fact I believe he could afford to do so. He has not figured what it is going to cost him to run an old synchronous condenser. If he will bal-

ance the capitalized cost, if he would scrap all those old transformers, he would make a certain saving each year which I think he will find would warrant spending sufficient capital right now to get new transformers. I believe that condition extends all over the Niagara district.

One town has 92 to 94 per cent. power factor, and it has approximately the same amount of day load as of night load, and the same number of transformers idle at night as it has hanging idle in the day time. The next town has a power factor of 76, with the same conditions, and they wonder what they can do to save the awful penalty. They could scrap their old transformers and buy new ones, but they think that is an awful waste, and as a consequence do not do it as a rule. So we overload the old transformer and keep on overloading until it burns up and we buy a new one. And the surprising part of it is how hard they are to kill. The reason for that is that our conditions are different from what most of us think they are, and we have got to do some more studying about this thing, we have to study our conditions a whole lot more than we have done. For instance, if we put up a 10 kw. transformer and we load it up to 125 or 150 per cent or to 200 per cent, and it does not burn out, we might ask ourselves "Why?" The answer is because the load is momentary. If we had the load constantly, they would naturally burn out. Each individual superintendent has to spend more time studying, and if he cannot study it himself, we will try to help him.

From Mr. Baker's paper, I was struck by the fact that the poor transformer designer is up against it hard. If he builds a long transformer, he is in trouble; and if he builds a short transformer he is in more trouble. And no matter what he builds it is going to cost the consumer more money. That is hardly correct. It would save the consumer money if he gets a good transformer.

Transformers should not be lightning arresters. We have had an awful lot of those things, a transformer designed with a short case with the connecting board up at the top, pushing the lid off every time it gets warm, and the oil flowing down on the sidewalk; also every time there is a lightning storm we know where to look for the trouble. Mr. Baker had enough troubles, in his paper, so I will not mention any more of them.

There is a decided misunderstanding about why we need 2400 volt transformers. We have to give 110 volts on the appliance, if we do not, it is of no use. We have a certain drop in the service; about the best you can expect to get on your secondary is 5 volts drop; there is one or two volts drop in the house. The regulation on the transformer is around 3 or 4 per cent. You add the two in the house to the five in the secondary and the three on the transformer and you must have 2400 volts on the primary to get 110 on the appliance. A town is penal-

ized because of the high exciting current of their poor old 2200 volt transformer working at 2400 volts.

At St. Mary's we had five transformers hanging on nearby posts. I said to the superintendent that he should cut some out, he only needed one there. He came back and said they couldn't do it because the fuses blew. I found the transformer fused for 200 per cent load, and that the trouble occurred on Sunday night, when there was no load, indicating that the exciting current was about 200 per cent of the full load current.

We must study our conditions; and I believe we will have to have 2300 volts coming out of the station of every individual town on the system. We have to do so in order to give service. Therefore we have to consider our transformers more than we have in the past. Mr. Baker told us that we lose ten per cent in the capacity, and we do. Our capacity may be increased 50 per cent with the same cost in power, with a slightly higher capital expenditure if low exciting current transformers can be obtained.

2400 volts seem to be common. Unfortunately the Canadian Association and the Hydro Commission's standard at present is 2200 volts. I think we are going to get that changed. It is quite a live question, and we probably will arrive at a new standard. Whether this Association could, by making a recommendation to the Commission, hasten the change in standard is something I do not know. What they should standardize on, I do not think this Association is really prepared to state; we have not put in time enough in figuring upon what you really want; and until we do we would not have a proper foundation for making a recommendation. I would suggest that we get down and study it and then standardize on 2400 volts.

From what observations I have been able to make, it appears to me that a transformer not having over 3 per cent exciting current at 2400 volts is what we want. We could rate the transformer 2300 volts, or whatever you like, as long as the exciting current does not amount to more than 3 per cent. at 2400 volts, which I believe is quite safe and would not give a bulged design. The poor designer again has to work due to the fact that we are always wanting something better. If we hadn't we would still have been getting the old shell type transformer with the excessive core loss, exciting current, etc.

I think we can afford very easily to pay the price. As a matter of fact it has been brought out that a 2400 volt transformer properly designed will not cost us eventually as much money as any other type.

Mr. McHenry: In our station, with our station transformers tapped up to 5 per cent, we get 2200 volts on the bus during the daytime, and we never get over 2200 volts until we have a very light load, particularly from midnight until six o'clock in the morning. Those conditions are beyond our control at the present time. I am very glad that there is some possibility of having that condition corrected in the near future.

It has been stated that we should

review the situation and see what can be done. We have done so, and are changing the transformers as fast as financial conditions permit. In spite of that we still have the effect of low power factor, because our conditions are different from those in most other Hydro municipalities. That just strengthens the argument which we have heard that every man must consider the situation for himself. We have to consider the matter from a different viewpoint from a municipality having a peak load of combined power and domestic light or largely domestic lighting.

Mr. J. Heeg, Guelph: I want to say this, just to bear out what Mr. Caster says. In Guelph we carried out tests on old time transformers which we had had in use for quite a long time; and we found some very bad conditions. Two years ago when the power cost was possibly thirty per cent less and the voltage was possibly ten per cent lower, there was not so much to worry about; but at the present time we are practically forced to get transformers operating on the maximum voltage which is liable to be on. When the cost of power goes up, as it did in the Niagara district, to as high as thirty per cent., we naturally want a transformer that will operate efficiently on the voltage.

Mr. D. B. Fleming, H.E.P.C. of Ont. I thought Mr. Caster was going to emit something about peaks. He told us about the poor conditions on the system and the high exciting current in different municipalities, and he told us afterwards about the better conditions we were getting now. In the transformer we are getting now, we call for a guarantee on the exciting current, at ten per cent. over voltage, which brings it up to 2400 volts on a 2200 volt rating.

Conditions are a great deal better than they were three years ago. There has been a great deal of co-operation among manufacturers and the transformers I believe are completely redesigned. They may be bulging out in another place, but they have brought the exciting current down, which is what the Commission is wanting. When the manufacturers know what we want, of course they can give it to us. I do not think we can complain very much about the transformers we are now getting; they are a great deal better than those we used to get.

Mr. Baker: The change in rate-making was the thing which brought out the low exciting current demand. Until the rates were based on the demand with the power factor penalty, it did not matter appreciably if the transformer did have a high exciting current. Of course the Power Company was losing out. But the moment you started to buy your power on the power factor basis, the matter was brought to a head.

Mr. Showalter: May I ask Mr. Baker to give us some relation between copper loss and exciting current. If Mr. Baker will point out how one is affected by the other, I think we will see how we cannot go too low with the exciting current without getting into trouble another way.

Mr. Baker: It is pretty hard to get figures without taking a specified design.

To bring your exciting current down you must reduce your magnetic density, which means putting more turns on your windings and using more copper. If you put in ten more turns, you increase the copper loss. It is just a matter of balancing the copper losses.

If you want a three per cent. exciting current, we will give it to you, but you will pay the price.

Mr. E. I. Sifton, Hamilton: I might throw out one little point here, which might be the subject of another paper. I have not heard it mentioned, but it seems to me that with a five per cent. voltage regulated system you are going to get as near as you want at 2300 volts. Five per cent. regulation will keep you at 2300 volts. I think with the regulation we are getting from the Ontario Commission from Niagara Falls that you will get quite close enough; very seldom you will get over the 2300 volts, if you will get 5 per cent. voltage regulation.

The subject of another paper that I speak of is the advisability and economy or otherwise of voltage regulators. I am a great believer in them, and it seems to me when we speak of 2400 volts we are getting into difficulties, that we are going too far.

Merchandising Committee Report

Mr. G. J. Mickler, H. E. P. C. of Ont.: I have been requested by Mr. Phelps to take his place on this particular occasion.

Before reading the report I may explain that it was the intention, when the Joint Committee met in April, to have one or two meetings of a Sub-Committee which was appointed at that time to consider the Report and compile the Report in Pamphlet form; but several things have prevented a meeting such as was intended being held; and as soon after this Convention as is possible we will have the Meeting and put this matter in proper shape. It was felt, also, that perhaps at this Convention some points might come up which ought also to be included in the pamphlet which we will prepare.

ON April 13th, a joint meeting of the Inside Merchandising Committee, represented by Messrs. R. T. Jeffrey, J. J. Jeffrey, L. G. Ireland, T. C. James, G. J. Mickler, and the Outside Merchandising Committee, represented by Messrs. A. T. Hicks, Oshawa; O. H. Scott, Belleville; J. B. Phelps, Sarnia; M. J. McHenry, Walkerville; A. W. J. Stewart, Toronto; O. M. Perry, Windsor; E. V. Buchanan, London; S. Millikin, Midland; A. B. Scott, Galt; H. F. Shearer, Welland; J. J.

Heeg, Guelph; E. W. Tobin, Stratford, was held.

The reports of the various subcommittees appointed in 1922 were presented.

The Servicing Committee report outlined the policy that should be adopted by Hydro Shops in the matter of servicing electrical appliances, as follows:

(1) A policy should be adopted of making all sales of electrical merchandise under the principle of "Satisfaction guaranteed or money refunded." The interpretation of this policy in detail should be liberal and broad. The customer should be educated to believe—and to have reason to believe—that the Hydro Shop has confidence in the articles sold to such an extent that if the customer is not satisfied—for any reason—the article may be returned for exchange or credit, and that the transaction will be carried out with cheerfulness, promptitude and courtesy.

(2) The Hydro Shop should select its goods with care and discretion, so that only appliances and articles of sound construction and quality may be offered to Hydro customers. We believe that it is better to lose some sales through failure to stock cheaply constructed or poorly designed articles, than to obtain the sales at the expense of having the inevitable resulting dissatisfaction attach itself to the Hydro Shop. In other words, put quality first, and we think that the sales, under proper guidance, will take care of themselves.

(3) Do not let the completion of the sale end the transaction. Make the customer understand that you are selling, not an article, but the completely satisfactory use of that article. Furthermore, do not leave off when you have planted that idea, actually follow it up. Just how this can be done depends on many things; the degree of enthusiasm and sincerity of the Manager of the Hydro Shop; the amount of elbow-room (financially) permitted by his commissioners; the degree of sympathy on the part of his commissioners towards merchandising by the Hydro Shops; the population of the municipality; the degree of wealth of the community; the number of other merchants handling electrical appliances. This makes it impossible to particularize. In general, the extent to which the sale of appliances is followed up in the home should be as great as the financial resources and latitude of authority will permit. In any event, no sale of any of the higher priced appliances should be considered as complete, until at least one call has been made by a representative of the Hydro Shop at the home of the purchaser, in order to assist the user of the appliance in learning to operate it in the correct way.

(4) As to repairs, the same factors as enumerated in No. 3 will largely control the policy. No Hydro Shop should embark upon the merchandising of electrical goods unless it is prepared to render the very best repair and maintenance service that its resources will permit. Almost every electrical device contains one or more parts subject to deterioration or wear and the purchaser of the article is en-

titled to a service which will renew these parts when they fail, with the greatest celerity and at a moderate cost.

The extent to which repairs can be made without sending articles back to the factory, depends largely upon the size of the municipality and each Hydro Shop must be guided by its local conditions, but the basis of the policy is simple and might be stated as follows: Repair parts should always be kept in stock and facilities provided for making repairs locally up to the limit of the resources of the Hydro Shop; repairs required beyond these resources can best be made at the factory. We are not in favor of the Hydro-Electric Power Commission of Ontario maintaining a repair department, and are convinced that the factory is the proper place to make repairs beyond the capacity of the Hydro Shop. "Lending appliances" should be kept on hand, which the customer can use while his appliance is being repaired. Particular attention should be given by the Manager to speed of execution of repairs, and a high grade of workmanship which will ensure to the owner an appliance returned in first-class operating condition, and with its appearance unmarred by its trip through the repair shop.

(5) It is of prime importance to the utility to keep all the appliances in the homes of its customers at work, and not lying idle on shelves owing to break-downs or defects. To accomplish this, it is necessary to get into the homes of the customers, and each Hydro Shop must devise a method best suited to its own conditions. In some cases the meter reader can obtain the entree. In other cases a special man can be assigned to the duty, but it is impossible to lay down any one scheme capable of universal application.

(6) Profits from the merchandising of electrical goods by the Hydro Shop, should not be considered as an addition to surplus and used for the reduction of rates, but rather as a fund created for use in buying publicity to aid in selling the idea of the use of electrical goods, and for expenditure in servicing the devices when they have been placed in the homes of the consumers. The use of profits in this way will tend just as strongly towards lower rates, through improvement of the municipal load factor and consequent improvement in net revenue.

(7) The Appliance Sales Manager should be a constant reader of Electrical Magazines, thus keeping himself posted on merchandising methods of others who have been successful. Along this line we would recommend that a freer exchange of ideas on merchandising and servicing of appliances be made through the medium of the Hydro Bulletin.

The Educational and Advertising Committee submitted the following report:

The Educational and Advertising Committee beg to report, that after due deliberation the following points suggest themselves as methods by which the use of electrical appliances in the home can be greatly increased; the operation of Hydro Shops carried on on a scientific basis, and co-operation between

contractor, dealers and Hydro Shops be greatly improved.

In submitting this report we are interspersing the discussions held relative to each point as it came up when discussed in sub-committee. The report is sub-divided into four general sub-divisions, A, B, C, D.

Under heading "A" have been suggested certain points for consideration for the betterment of merchandising methods. "B" and "C" deal with the education of the consumer and "D" with the electrical dealer and contractor, who too often look with fear and suspicion on merchandising by central stations. The confidence of these men must be gotten and held, and their co-operation secured by the Hydro municipalities to permit of the fullest possible education of the consumer.

A. Proper Merchandising Methods.

1. Not looking on private dealers as competitors but seek to have a friendly spirit of co-operation.

After some discussion it was thought that this could be best brought about by Hydro Managers taking the initiative in disarming the dealers by showing friendliness and a spirit of co-operation first. It was proposed that all local managers be advised of the proper way to co-operate with the dealers, and also the results to be desired from such co-operation, and that they should be advised of the desire of fostering a friendly spirit among them.

2. More interest in the fact that a customer has an electric appliance than in the fact that it may have been purchased at some place other than a Hydro Shop.

The friendly spirit that would be engendered by the methods proposed in (1) would instil a feeling in the consumers' minds that electrical appliances of reliable character can be purchased from dealers as well as the Hydro Shop and this will also cause dealers and Hydro Shops alike to pay attention to the servicing of electrical appliances, no matter where they have been purchased.

3. To place Shop on a proper basis, by making it pay its own way, bear its own proportion of expense, rather than be carried along at the expense of the Light & Power Departments.

This is dependent upon a proper bookkeeping system.

4. Proper realization of what overhead expenses entail, and what should be a fair overhead percentage of sales.

It was suggested that the Burroughes Efficiency expert address the next A. M. E. U. Convention, on overhead, or some such subject, and this has already been done, with very good results.

5. Maintaining a fair re-sale price on goods which will be uniform in all Hydro Shops, and discouragement of price-cutting except perhaps in shopworn goods.

There is a great necessity for educating all local managers in the true cost of merchandising, to satisfy them that re-sale prices must be maintained.

6. Co-operation between Shops, so that one may help the other to move certain goods that may be

selling slowly in one or more particular municipalities.

7. Interchange of good selling ideas.

The Bulletin and Sales Department of the Hydro Commission were deemed the proper media for disseminating ideas on merchandising to Hydro Shop managers.

8. What is the proper amount of stock to carry, and what should be considered a fair turnover in the year.

This can best be determined by a proper study of the manner in which merchandise of all different classes carried in stock is disposed of, with particular regard to the locality, as what moves rapidly in one locality, may move slowly in another.

9. Encouraging every municipality to maintain a high-class Shop, where only the best of electrical appliances can be purchased.

In this regard it was felt that Hydro Shops should establish the lead, and that they should be the most up-to-date electrical Shops in every municipality, also that only the very best of electrical appliances should be on sale in these Shops.

10. While it is desirable to operate a Shop with a substantial surplus each year, that should not be the main object.

The offering for sale of the best and approved appliances, having well-dressed windows, and advertising of a high order worthy of Hydro, education of the people to the advantages of electricity, and giving the consumer the best possible service, should be the first consideration.

11. Surplus earnings should be turned back into the business for the introduction of new devices, and the working out of further educational features.

12. Methods of stock-keeping, purchasing and accounting, such as would be found in any high-class establishment, should be introduced.

13. A uniform sign and advertising insignia should be adopted for use by all Hydro Shops.

14. Every appliance sold, particularly ranges and washers, should be thoroughly demonstrated to the housewife, as the proper understanding of the care and use of any appliance will save considerable servicing.

15. A uniform schedule for free servicing of appliances.

16. All Hydro officers and sales staff, including Head Office, should have talks at least every two weeks on the correct method of selling merchandising, and also discussion of the various appliances handled by Hydro Shops.

In connection with No. 16, no definite plans were made for conducting these talks to the Hydro sales staff, but an educational campaign must be carried on, and some method should be adopted for conducting talks at various periods to all of the staffs in Hydro municipalities. It was proposed in this connection also to canvass every Hydro employee, to find out what electrical appliances he has in the house, to see how far this talk on the use of appliances would have to be carried among our own people before we try to educate the public.

This was done by distributing cards among the principal Hydro-municipalities to be filled in by the employees, and to indicate what appliances were being used. Out of 490 cards returned the following appliances were shown to be in use by employees:

Irons	487
Toasters	349
Percolators	128
Grills	133
Vacuum cleaners	203
Water heaters	35
Dish washers	1
Air heaters	159
Clothes washers	149
Ranges	105
Refrigerators	2
Miscellaneous	20

These results show that a great deal of effort must be put behind sales to our own people before we can expect others to accept the theories and sales arguments used to dispose of electrical appliances.

"*B.*" *Advertising.*

1. Preparation of copy by a good advertising agency, and the furnishing of mats to the different Shops. This to be prepared and furnished on a certain schedule, which will permit of advertising appliances at the proper time each year.

2. Encouragement of the Shops to tie-up their window displays with this advertising.

3. Preparations of pamphlets for distribution to the consumer with his monthly bill.

4. Arrangements for demonstrations and special displays.

5. Making use of the matter furnished by the Society for Electrical Development.

The Secretary of the A.M.E.U. has already subscribed for associate membership in the S.E.D., and placed same at the disposal of the Sales Department of the H.E.P.C.

6. Suggestions for good window dressing.

"*C.*" *Education of Public on Proper House Wiring.*

1. Advantages of sufficient outlets.

2. Adequate service when house is built and re-wired to permit of the fullest use of electricity.

3. This can be accomplished best by the modern "Electric Home" idea, which has already been successfully carried on.

Education of the public to proper house wiring is a subject which requires the co-operation of the contractor dealers with the Hydro Shops, and in this connection this co-operation must be obtained before the public can be educated to the need for sufficient outlets.

Architects and building contractors should be approached when building permits are taken out, so that when buildings are contemplated some method can be employed to educate the architect and the contractor, and finally the owner. as to the advisability of installing sufficient outlets in the home.

"*D.*" *Education of Private Electrical Dealer and Contractor.*

1. Fostering kindly relations and the spirit of co-operation.

2. Getting them to look on the Central Stations maintaining Shops,

not as competitors, but as co-workers in extending the use of electricity.

3. Convincing them that the entering of Hydro into merchandising will not decrease but increase their sales.

4. Their co-operation is absolutely necessary to carry out suggestions in "C."

The Purchasing Committee reported that through the Hydro Sales Department they secured a list of all the appliances sold in the various Hydro municipalities during the year 1921, and the prospects for 1922, which was intended to be used as a means for co-ordinating the buying of electrical appliances for all Hydro Shops, to secure the very best prices and terms. A summary of this information was presented to the members of the Committee, but no action was taken.

The Accounting Committee had no meetings during the year, but the Secretary reported that an accounting system to meet the requirements of the average Hydro Shop had been devised by him, and put into operation in two or three of the municipalities to try out; also that after operating for a year and ironing out the wrinkles in the system, that it was ready for universal adoption by all the Hydro Shops, and that plans would be laid for installation of this system wherever necessary.

After presenting these reports the Committee appointed a sub-committee composed of Mr. M. J. McHenry, Mr. L. G. Ireland, Mr. A. W. J. Stewart, Mr. G. J. Mickler, to collaborate the reports, and prepare in printed form a pamphlet containing what is thought best in each of them as a guide for Hydro Shop managers and appliance salesmen, carrying on their work as successful Hydro Shop managers; also to place in this pamphlet a discussion of the working of the accounting system, which it is desirable to keep.

After some discussion on the HYDRO LAMP, the following resolution was put to the meeting, namely:

It was moved by Mr. McHenry, seconded by Mr. Shearer, that the Merchandising Committee go on record as having faith in the HYDRO LAMP, and that if the Sales Department supplies local managers with cuts for advertising purposes, the local Commission will support the HYDRO LAMP with local advertising to get it before the people as much as possible. The resolution was carried.

It was also resolved on a motion by Mr. Perry, seconded by Mr. O. H. Scott, that the bulletin, "The Hydro Lamp," be continued in its present state, and that efforts be made to make it as "snappy" as possible.

It was also resolved on motion by Mr. Shearer, seconded by Mr. Perry, that the Merchandising Committee go on record as favoring the continuation of the Hydro Sales Department acting as purchasers for various municipalities where requested, and that the development of the Department along the line of education and publicity be active-

ly carried on, and that any loss in connection with such operations be considered by the H.E.P.C. as a general overhead expense, and charged to the municipalities as part of the cost of power. This was also carried.

Respectfully submitted,
G. J. Mickler,
Secretary.

Discussion

Mr. J. E. B. Phelps, Sarnia: Mr. President and Gentlemen. Before opening the discussion on this paper I want to take this first opportunity of thanking the members of the Association for electing me as a Vice-President at the election of Officers in January. I can only look on this election to the Vice-Presidency in this Association as practically a vote of confidence. You all know what I went through in the City of Sarnia. I suppose I was one of the best advertised men from Dan to Beersheba and from Joppa to Jerusalem, and it did not cost me anything. I think we should have got into this paper something along the lines of free advertising.

However, I look upon the election of myself to this office in your Association not so much as a personal matter as evidence that the Members of the Association wanted to see a fellow given a square deal, and that you were bound to do all you could, when a fellow needed a friend, to show your loyalty; and I want to tell you, gentlemen, that I appreciate it.

This Committee has had several meetings not only this year but last year. The question of merchandising is a big question, and we need all the assistance that can be given the Committee. If we have left anything out of this Report which you consider vital to the selling of appliances, to merchandising, we want you to tell us. We want you to freely bring out your ideas.

There was a hue and cry raised that the Hydro shops were not playing fair with the contractor-dealers. I believe from a couple of towns, the contractor-dealer went before the Gregory Commission to make a complaint because of the work of the Hydro shops.

You will see in the Report that it is not the policy of the Hydro dealer to conflict with those shops, because we are in reality servicing the public, and we should not be fighting one another. If we get together in co-operation and back one another up we will be able to give the public a far better service, and, incidentally, it will be better for everybody concerned. And when the Hydro shops play fair with the contractor-dealers in their own Municipalities, they should also play fair with one another. They should not get over onto the other fellows ground. That has been done. We cannot deny the fact that we have municipalities represented here to-day who have been peddling appliances in other Municipalities.

We heard that threshed out at the last Convention, and it is a regretable fact. This is not the place to wash dirty linen, that is for electric washers.

We want to play fair, serve the people in our Municipalities, and let the other fellow do the same.

I would like to have the members present enter freely into the discussion and give us their ideas.

Mr. O. H. Scott, Belleville: Mr. President. There are so many things that one might touch on in connection with this very large subject of merchandising that one rather hesitates to get up and start speaking upon it, because many things come into your mind and can only be touched on briefly.

There is one thing, however, that has been uppermost in my mind for a good many years, and that is the fact that everybody, all the Municipal Utilities which have an electric shop, should adopt some standard insignia, some standard name, from the East of the Province to the West of it.

I think it is universally stated by manufacturers and jobbers that there is no outlet for the sale of electrical merchandise so good as through the Hydro shops; and we men who are in charge of these shops do not realize fully, it seems to me, the value of a common name. It does not make any difference whether the name is the Public Utilities of London or the Hydro Commission of Hamilton and so on, we can all adopt one name for the merchandizing end of the business. It seems to me that the value of that is going to increase the confidence many fold in the people who use the electrical appliances.

There is one thing which demonstrates to my mind possibly more than anything else the importance of this thing, and that is that there is very seldom a consumer leaves the lines now who does not come in and settle up his bill before he goes. We are finding it that way in Belleville. We know that if they leave Belleville for Toronto, that they will get a bill in Toronto within a week and unless the bill is paid, they cannot enjoy the use of the Hydro in Toronto.

We want to adopt some insignia which we can use in our window dressing.

You have practically to adopt a uniform price. Mrs. Jones does not want to go to Toronto and get a washer at a certain price and then come back to Belleville and see a washer at another price. Insignia will help towards uniformity in prices.

This is all I wish to speak about at the present time, except that I would like to ask some of the members from other Utilities to tell me, for my information, what the cost of installing ranges is in their various Municipalities.

Mr. Phelps: Mr. President, in the City of Sarnia we do not do any wiring in connection with our Hydro shop. We were the first people to introduce the sale of electric ranges in the city. After we had done the missionary work, so that people were beginning to buy ranges, then the other contractor-dealers thought they ought to get a finger in the pie, and rightly so,

and then started to sell ranges. It got to the point where if I wanted to get a price on wiring in a range I had to go to the contractor-dealer and send him up to the house to get his price on the job; and if he was wide awake and wanted to be crooked with me, he could probably get ahead of me and sell the range himself. So that I had to show them my hand, and I called the contractor-dealers together and talked about installing ranges in the homes; and developed a method by which I could go out and measure up and give the people a price, and any of those men would wire for that price. The price ranges from $35 to $50, now, and it is working out very satisfactorily. You all know that some homes can be wired far more cheaply than others. Some already have a conduit service, in some cases, with a large enough entry box to take care of a range. Others just have the old-fashioned way, and when you come to rewire you have to carry the conduit service down into the basement and hook up the other services in the home, and it costs somebody money.

I might say, Mr. President, that we give the customer the option of choosing his own contractor-dealer to do the wiring. In case they have no choice in the matter, we guarantee to hand the business around to the contractor-dealers in turn, so that they all get a fair share of the business.

Mr. M.J. McHenry, Walkerville: I might say that in Walkerville we have worked on a different programme. We are installing ranges on a flat rate of $27.50 in any house where the meter is already in the basement and where a sixty ampere three wire service is sufficient.

If it is too large for a sixty ampere service, we make it a special job. We have not any wiring department. About every six months we call for tenders from the various contractors who are working in our Municipality, on a flat rate for the installation of range services. And we pick from the tenders received a reliable contractor who gives us the lowest price. Our present figure is $27.50 per range.

Mr. E. W. Tobin, Stratford: Mr. Chairman, in Stratford, we do our own wiring. At the outset we took up with the contractor-dealers the question of range installation, and asked them if they would do our wiring at a certain figure. The price which we took was the cost in effect in London at the time, $35 for number 6 service; $45 for number 4 service, including picking up the light service and also the wiring necessary for the range installation. We are able to get one of the contractor-dealers to take it on that basis and ran along for possibly four months on that basis; but finally we had to go into it on our own account. The contractor whom we got hold of was the only one who would do it on those conditions; but we found they would go into the home and claim that they were not getting enough money for the work they were doing, so as to account for any rough work that they did. Therefore we concluded that we had to go into it and do that work ourselves. We install a number 6

service for $35 and a number 4 for $45. That includes all the necessary wiring.

We have recapitulated all the wiring jobs done last year, and our gross profit on the wiring jobs last year was 42 per cent of our cost; and besides that we have a lot better relationship between ourselves and consumers, because all the work is done by our own men who are directly responsible to us, and we can give the person in a pinch a whole lot better service than they could get through the contractor; and our experience in Stratford has been very strongly in favour of doing our own wiring.

Mr. J. J. Heeg, Guelph: I would like to say a few words, as a member of the Merchandising Committee, on the report just read by Mr. Mickler. I hope the members of the Association will appreciate the work your Committee has done, because you will see it was no small job; and the valuable information in that report, I think, is going to be a very valuable asset to every municipality connected with this Association.

The pointers that we get and the things that go with public utility merchandising are altogether different from the ordinary contractor-dealer or merchant. We, as members of Public Utilities, and those having charge, naturally have to give what your report says, a real service behind everything that is sold. The question of looking at the profit only and letting it go at that is absolutely wrong from our point of view. We have to keep the appliance in working order. That means, of course, we sell the power and get the kilowatt hours which the appliance is really sold for.

In Guelph we have made the practice of servicing behind everything as nearly 100 per cent as possible. If an appliance goes out of commission, it is either a case of making a repair speedily or of supplying the customer with an appliance to tide him over in the meantime.

The question of wiring has also a big influence upon the development of selling appliances. We have done wiring for, possibly, twenty-five or thirty years, long before the City took it over; and we have found it is a very valuable feature in connection with public utility business.

The question of costs of installing ranges is a pretty hard thing to define. It depends a good deal upon the size of the range and also upon where the service comes in, and the size of it. We have found that from the small ranges up to the larger sizes, which would mean either a 30 amp. service, 3-wire, 220, up to the 100 amp. service, 3-wire, 220, the cost will vary anywhere from $25 to $75; and, as Mr. Tobin pointed out, a good profit can be made from wiring if it is well conducted.

Mr. J. H. Bennett, Barrie: Mr. Chairman, how can these gentlemen escape the inspection, if they can get the wiring done at that cost? The specification which the inspector in our town has makes it that we cannot get wiring at any such cost as these gentlemen give. I would like to know how they get by the inspection part.

Mr. Tobin: As far as that is concerned, our work has all to pass the

Hydro inspection, and is of the same standard as any other work.

Mr. W. H. Childs, Hamilton: Mr. Chairman, we in Hamilton sent out a letter to each wiring contractor in the city asking for tenders on four different styles of wiring. The lowest tender we got was $35 for three No. 8's, 30 ampere, to take care of the small range. Three No. 6's, 60 ampere, to the range, was somewhere above $45, but I have just forgotten the exact amount. The larger size was three No. 4's, 100 ampere, $65. I do not mean that the wiremen tendered on those prices, but I mean that is the price we charge, and we make approximately 10 per cent. on the price that they quoted us, in turning it over to the customer. I do not believe any municipality can do business unless they make some profit. If the contractor quoted us $41, we would charge $45, so that we would make some slight profit on the job for the bookkeeping that is necessary in connection with it.

We have gone into the matter very carefully in Hamilton, and I really cannot see how in Stratford they can make a profit of 42 per cent. on a $35 installation. If you can get 100 per cent. efficiency, a man working every minute with a job to go to as soon as he finished the last one, you might get a very fair price; but at a price of $35, I am afraid that the wiring contractor must steal the material from the Commission to do his work. We keep ours carefully locked up.

I feel that we are being forced into wiring. Before we started to quote these flat prices for the different styles of installation, which by the way only cover a service where the meter is already in the basement, and if the service comes in upstairs, there is an extra charge which the customer must arrange with the wireman before he goes on with the work, the cost of services used to run about $65 or $75, and we have brought it down to $45; and we are doing fairly good business. Last month there were 96 ranges installed on our lines. that is during the month of May.

I sometimes feel that perhaps the contractor-dealer or wireman who is doing the work is getting too much; but so far, we have not been successful in getting anything like a competitive price; and we may be forced into doing the wiring; but my fondest hope will be realized if we can equal the price that Stratford is doing it for, I can assure you.

Mr. E. R. Smithrim, Stratford: Mr. Chairman, we practically do all the wiring in Strathroy, and at the present time we charge $35 for No. 6 service and three No. 8's to range. I do not think myself that this is a fair price for all the jobs, because some of the houses where the service is already in the basement pay a pretty big profit. In others we have to go to the attic for the service, and we lose money on them, and we take that off the profit on the range. The total of the installations would give us a small profit, but not as much as we should get on all our range installations. We live too close to London to vary much from their prices, and we have adopted this plan to make a profit on the total wiring.

On some jobs we get close to the cost; on others we make 75 to close to 100 per cent. I do not understand how anyone can do wiring for $35, unless the service is already in the basement and they have only a short distance to go to the range, and make a profit of more than 10 per cent.

I would like to ask Mr. McHenry of Walkerville if their price covers also the cost of connecting from where the meter is put in the basement to the wires in the house, where the original wiring is in the attic, or is that charged as an extra?

Mr. McHenry: In any case where the wire is connected into the attic the contractor gives a special figure, and the householder agrees to that before the work is commenced.

Mr. Smithrim: Then that would make a pretty good thing. May I ask Mr. Tobin, of Stratford, if the $35 covers the change where the wiring comes into the attic?

Mr. Tobin: It covers it, wherever the wiring is.

Mr. Smithrim: I cannot figure where you can make 42 per cent profit. I think the material with the labor will run over $35.

Mr. Mickler: Mr. Chairman and gentlemen: In order to clear up some misunderstanding that may be creeping into the minds of some of you in connection with Stratford's operation, I would like to explain just how the figures were arrived at which Mr. Tobin has quoted.

The total number of wiring jobs done last year, since they were in the wiring business, including some large wiring jobs, and a few small ones, was 200, and the average charge to the consumer was $41.14. The odd cents are caused by some of the large jobs being done on a contract price, not on a flat price. The $41.14 for these jobs paid for the material and labor and also provided, as Mr. Tobin has said, 42 per cent gross profit on the cost, that cost being the material and labor costs only.

The bookkeeping system which we have in Stratford and which we hope to ultimately have in every Hydro town gives the actual cost for labor and material only, the other costs are treated as overhead. As a matter of fact in Stratford the overhead brought the profit down to less than 10 per cent. on the selling price, which I figure is reasonable.

Mr. A. W. J. Stewart, Toronto: In Toronto I think we have a scheme a little different, on the installation, from anything which has been brought out to-day. When we started out on the installation of ranges, we put on a flat price of $45, which was considerably less than the average charge before that time. After running for about five or six months, we reduced that to $40, because we found that that could be done and still show a small profit. We do not do any wiring ourselves. All the jobs are done by outside contractors; we do not tie up with any one contractor. A range is sold to a customer and he is told at the time he buys it how much we will install it for. If it is 70 amperes or under we charge him $40, regardless of the size of the house or what he has in it, provided it is

not an apartment or a duplex. If it is more than 70 amperes we charge him $45.

As soon as the job is sold, our own man goes out and looks at the job and makes a sketch and a list of the material; and that is handed to three or four contractors in turn and they bid on it without going to the job at all. That saves the time of going out to look at the jobs. The job is then let to the lowest tenderer, and we find that at $40 and $45 we can get out on it comfortably. We do not make a large profit and do not want to.

We also have a flat list price for water heaters in conjunction with ranges. It includes the connections and also the covering of the tank. If the customer does not want the tank covered, we will not do the job. We charge $75 for the range and water heater, combined, complete, and we find that we get out on that price. We have not had any trouble in working this, excepting that occasionally a contractor thinks that the price is a little bit low. The jobs are all let by tender and the prices that we charge are based on the price handed in from time to time by the contractors themselves. We have found it to work out very satisfactorily in that way.

Last month we sold, I think, about 220 ranges, and quite a large percentage of those are sold installed, and are put in on this basis.

Mr. Childs: I would like to ask Mr. Tobin how many men they have employed on their staff in wiring.

Mr. Tobin: We have at the present time, I think it is eight. Last year I think we had six or seven.

Mr. Childs: Then they installed four a week.

Mr. Tobin: We installed about 350 last year, since we started our own wiring. We started about the middle of February, and we took over the wiring from May or June.

Mr. G. W. Blay, London: In London we have a flat rate of $35 for a three No. 8 service and of $50 for three No. 6's.

In connection with all the water heaters installed, we send a man out to give an estimate on each individual job before it is put in, and we will not install them unless the tank is covered, at the present time.

Mr. Scott: Mr. President, I think this discussion has brought out the fact that the Merchandising Committee of our Association has still a lot of work to do. We have here a variation in price between $27.50 and $75 for the installation of a range in various parts of Ontario. There are several things which might be said. Possibly one town is not paying the same price for its labor as is being paid in another town. One town is buying its material cheaper than another town. Mr. Hall's Inspection Department may not be carrying out the rules uniformly, and insisting on the same standard of work in the various parts of the Province.

Possibly those three points, in a nutshell, will cover the difference in the various prices of which we have heard here.

Down at Belleville we cannot install the smallest range in the most modern house and get anything

more than 10 per cent. profit on the selling price at less than $45. I think we shall have to send some of our wiremen and our wire foremen up to Western Ontario to find out where the shortcuts are.

This is all a part of the work of our Merchandising Committee. I think the discussion has been splendid. I would now like to start a discussion on the size of flat rate water heaters being recommended by the managers in various municipalities.

Mr. R. T. Jeffery, H.E.P.C. of Ontario: Before leaving that subject, I would like to ask Mr. Hall something. Mr. Scott said that there were very likely several reasons for the variation in the cost of installing ranges, one of which would be perhaps a difference in the specifications or in the strictness of the inspector; and I was going to ask Mr. Hall whether there was any variation in those rules. I do not think there is. I think they have as nearly as can be humanly possible an even and uniform system of specification for the installation of ranges.

Mr. H. D. Rothwell, H.E.P.C. of Ontario: I think I had one of the first water heaters that Moffatts manufactured, and I installed it rather as an experiment, back in 1919. That was a heater with six sixty watt element for flat rate purposes and 2,000 watts for emergency. Since putting that in I have never connected the six sixty but I have always used it on the low heat of the 2,000, which gave 500 watts. At that time I had an idea that the insulation of the tank would be a very important factor and I insulated the tank with an inch of hair felt, an inch of felt paper, and an inch of asbestos cement, giving a depth of three inches. That was thought by many to be quite a lot of insulation; but on the experiments I carried out I found that by heating the tank until it was hot at the bottom and leaving it standing with no water taken from it, I could get water after 48 hours warm enough for a bath. I think that has led to some experiments that were carried on in the laboratory. Perhaps someone here knows something about them. Most of them were published in the Bulletin. I believe the insulation is the important factor, and that you should have at least 1½ inches to 2 inches of hair felt. I do not believe that the asbestos or paper air cell will at all touch the insulation of hair felt.

Five hundred watts, with a family of three or four, should give sufficient water; in many instances they are using them as low as 400 watts, and I know of one that is 300 watts and giving satisfactory service.

Mr. Jeffery: I may say that in my house I have installed a flat rate heater, 500 watts for the low element. At the time I thought 500 would be too small, and I had it 660 flat rate, and I had to turn it out every night for steam came out every time you opened the hot water faucet. I find that gives all the hot water we need for a family of five. Over the tank is 1½ inches of hair felt and three thicknesses of corrugated paper.

I recommended the 660 element for a friend of mine, a doctor, and he

could not get any hot water at all. He found his piping was not in properly, and he had it changed. The piping in his house was such that there was a return from the bottom of the tank to the top and it always gave him instantaneous hot water. He changed his hot water heater two or three times and still did not get enough hot water with 750 watts; but after a while he told me he believed he was using more hot water than he required, that he had a maid who was somewhat wasteful with hot water and since he discharged the maid he has had plenty of hot water.

If the tank is properly lagged and if the pipe is properly installed 500 watts will give all the hot water any small family will require.

Mr. Phelps: Mr. President, I have come to the conclusion that the discussion of electric water heaters should really be in a plumbers' convention and not at an electrical convention. We have installed some water heaters in Sarnia, and we have got the heaters so hot that they burned the lagging, but they failed to get hot water in the tank.

Mr. McHenry: Mr. President, in connection with water heaters, the experience which has been related by various members we have found to be correct in several instances. We have installed, during the last five or six months, in the neighborhood of some 50 or 60 flat rate heaters. We have standardized on 750 flat rate, 2,250 watts on the meter, which we have found to be satisfactory in about 50 per cent. of the cases. We have found, however, that in about one-half of the installations we have had trouble. We have always recommended lagging, and in fact we tell every customer that we will not guarantee the heater to be of any value at all unless the tank is properly covered. We do find, however, that the plumbing in a great many houses is not satisfactory for an electric hot water heater, and that a considerable expense is involved in changing the plumbing in order that they may get satisfactory results from the hot water heater.

On this account we have been unable to establish a flat rate for installing hot water heaters, because we find in every other house we go to it is necessary to make changes in the plumbing, which throws out the scheme of the flat rate for the installation of the heater.

There are several features besides the plumbing on which we find you cannot strike an average on the water consumption for a family of a given number. We tried it out and found that where it worked very nicely for one family of, say, four people, where they would use thirty gallons of water a day, distributed in such a way that 750 watt flat rate will carry it, we find that in the next family of four they use twice as much water and we could not get any results. So that a question comes in there which is very difficult, involving the education of the public towards economy in the use of water on the electric heater on the flat rate.

We have now instructed our men, wherever a water heater is installed, to see that there are no taps leaking, because we found that a lot of

hot water was being wasted and that that was the cause of complaints of failure to obtain results on the heaters.

Mr. J.J. Heeg, Guelph: One point has not been touched upon in this discussion, which is without doubt very valuable to all of us, because water heaters are a desirable load.

What we have found in Guelph to cause trouble is that the average plumber will not take enough interest in the installation of a water heater. As Mr. Phelps might say, the plumbers really do need some education, and it would be a good thing if they were here.

I have found that in turning on the hot water the cold water will by-pass down through the tube up through the heater and through the hot water tap and leave the tank full of hot water. Plumbers usually put in a device costing $3 or $4. We put in a small disc of galvanized iron with a hole about one-eighth of an inch; and the minute you turn on your hot water tap the water will come through that hole very slowly and, consequently, you have to draw off the tank. It is a very valuable feature and inexpensive.

We tell our customers in Guelph that a thousand watts will compete with the ordinary coil in a furnace. If they will give the same consideration to a thousand watt heater that they would give to a coil in the furnace they will get a good service. If they draw all the water off the tank when they have a coil they will have to wait until the coil heats more.

During the night, if they have a heavy fire in the furnace, banked up fairly close to the coil, they are going to have very hot water during the night, while with an electric water heater you can turn it down to 250 watts and will have hot water at a very low cost. To anybody who wants a 3,000 watt heater and get water quick, we recommend them to put in a gas heater.

Mr. McHenry: with reference to the report of the Merchandising Committee. I happen to be a member of this Committee and am interested in merchandising. I feel that the report which has been presented is one which the members of this Association should find very valuable. I think the report should receive the full support of all the utilities who are members of this Association and that the Committee should be permitted to go ahead and carry on and complete the work which it has started.

Several of the Hydro municipalities have been operating Hydro shops for a considerable period; others have been operating for a much shorter time while others have just started. A good many of them have not operated at all; and speaking for the benefit of those utilities who have not inaugurated anything in the nature of an appliance business, I would like to refer the superintendents and managers to an article* which recently appeared, the last issue, I believe, in the Electric World, written by an official of the Edison Electrical

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*A copy of the article referred to by Mr. McHenry will be found on page 247 of this issue.

Appliance Co., Chicago, and entitled, "Should Central Stations Merchandise?" It is one of the best written articles along the line of that very much discussed question, Should the central station merchandise appliances? This gentleman is very much in favor, and his arguments in favor of central station merchandising appliances are to my mind exceptionally good and, I think, cover the ground so well that there is no reason left why the central station should not merchandise appliances; but he brings out the point that there is no use in any central station of any kind whatsoever, whether publicly or privately owned, attempting to carry on a merchandise department unless that department is on a business basis. It must be operated as a private dealer's business would be operated.

I think a great many of the Hydro municipalities who have operated Hydro shops have come to the same conclusion after years of experience. A great many municipalities went into this rather blindly because there were very few of us, or probably none of us, who had any experience in operating a merchandising business of this type, and it is only through experience that we have learned certain things which we must guard against in operating such a business.

My own idea is that the merchandising department of any Hydro shop or any central station must be a separate department which carries itself entirely and pays all its own expenses and does not impose any burden whatever on the other departments of the utility; and I think that is what we are approaching when we attempt to outline a basic policy. This report of the Merchandising Committee does not attempt to particularize and say that any municipality shall do certain things in regard to certain details, because conditions in municipalities vary and I do not think it is possible to prepare a policy for the Hydro shops which will be complete in every detail, but it is possible to outline a basic policy under which all the Hydro shops can operate.

It is possible to outline or to bring into effect a system of general advertising which will be used and applied by every Hydro shop in the Province of Ontario. It is possible to have some form of insignia, as Mr. Scott has outlined, which will be used by every Hydro shop in the Province. It is further possible to have a basic system of accounting. They may elaborate upon it, but the basic system can be the same everywhere.

The broad general policy under which all appliances are sold should be the same in every Hydro shop, and if that were followed I think that would eliminate some of the objections, and practically all of the objections which are raised by both private citizens and contractor-dealers to the operation of Hydro shops at the present time.

To my mind there is only one way by which we can effect a scheme of this nature; and that brings me back to the old question which I have brought up before this Association for the last two years and which

was brought to the attention of this Association by Mr. Scott, and that is that we cannot possibly make any use of this report or of the valuable experience obtained by the various municipalities unless we co-operate as members of the utilities of this Association.

I am very glad to be able to say that I have seen better signs of co-operation of the utilities here to-day than I have previously. I think we are getting to the point where we realize that we must get down to a solid foundation and that we are all working along the same general lines.

With your permission, I would like to open a short discussion by asking to have every utility at present operating a Hydro shop say something as to where they have obtained their capital to carry on their business. I do not think there is a Hydro shop of any size in the Province that has not got a certain amount of capital involved; and most of the larger shops have a tremendous amount of capital involved not only in stock on hand but also in accounts receivable; that is for appliances which have been sold on the instalment plan and for which the money is outstanding.

What I want to find out is if that capital for the carrying on of this business is supplied from the Light and Power Department and whether the Department selling the utilities pays back to the Light and Power Department interest on the capital supplied, and what rate of interest, if any, they use, and how they arrive at the amount of capital which is carrying their merchandising business.

I might say that in our own municipality we are paying interest on the capital involved in the Merchandising Department at the rate of 6 per cent. per annum to the Power and Light Department. Last year it was $3,890. At the same time we are making our Merchandising Department carry itself in every respect. It is being charged rental for the portion of the Hydro building which it uses, and it is being charged up with everything which we can think of, and which it would be fair to charge against it.

Mr. Mickler: As to Mr. McHenry's suggestion that a uniform accounting system should be in force in every municipality, I might just say that during the past six weeks I have devoted some of my time to going from one municipality to another, where Hydro shops are in operation, starting out a uniform accounting system. At the present time there are at least six under way and three or four more are about to start.

In this uniform accounting system most of the things which Mr. McHenry mentions will be taken care of, interest on the money invested, which can be determined by the control accounts which the accounting system will establish; the overhead, including rent, salaries, and whatever other expense there may be involved in the operation of the Department.

I want to emphasize Mr. McHenry's statement that every Hydro shop should be self-sustain-

ing; and in operating these accounting systems throughout the Province, so far as Hydro shops are concerned, at the end of every year when the books are closed it will devolve upon the auditors of the Commission to see that all expenses properly chargeable to the Hydro shops are put through the Hydro shop accounting system into the Hydro shop operating statement, and with the thorough co-operation of every Hydro shop manager this can be brought about. There is no reason to mince matters at all or to try to cover up one expense with another. We are competing with other people in the same line of business and as there is quite a feeling prevailing at the present time against the operation of Hydro shops, we must make it as easy for ourselves as possible by seeing that we are operating fairly, and we must make it as easy as possible for our competitors, the contractor-dealers, because we need them to stimulate our business.

Mr. R. C. McCollum, H.E.P.C. of Ont.: In going over the accounts, I am forced to admit there is an element which is almost tragic in that many Hydro shops are operated at a loss which has ultimately to be made up from the revenue from rates. We are very apt to forget that merchandising is a business in itself, and that training as an accountant or an engineer or any other line does not necessarily make a man a merchant. By looking over our own town, where we live, and the stores which have changed hands, and the signs which have been up and have come down to be replaced by other signs during a number of years, we feel bound to acknowledge that it is not everybody who sets up in business who makes a success of it.

The ordinary Hydro manager is really handicapped by the fact that he has practically unlimited credit and is not bound down like the individual by the need of buying material only as his business requires it. Most Hydro shops which have shown losses could probably trace it in the last analysis to overstocking, buying material at 5 per cent. discount and losing 25 per cent. on bad sales and old stock.

The accounting system which Mr. Mickler has spoken of has been introduced in some towns, but unless we start buying material in related quantities, according to the volume of sales, and turning it over frequently, selling at a fair margin of profit which will enable our competitors to do business successfully and safeguard our stock so that we can at any time tell whether or not all of the material purchased has been sold and accounted for, and have a regular accounting system to show in a balance sheet whether the business is being carried on at a profit, there is bound to be room for very serious criticism.

Mr. Mickler and I went over the accounts of a municipality a short time ago where they have a Hydro store, a very nice little shop, apparently well operated and economically run, but there was a loss of many thousands of dollars shown up in their balance sheet, and there were no records in that shop from which we could determine how that loss

developed, whether material was sold at a loss or whether it was sold without record, or whether the proceeds had never gone into the treasury, but certainly there was a big loss there which up to the present time could not be explained. I maintain that that is the worst kind of unfair competition, to have a little shop operating at a loss competing with merchants who had to pay rent and make a profit. It means that nobody else can compete successfully with them without losing money. Merchandising is a business by itself and requires much training; and the ability to run a show-room and fill it with seasonably and properly purchased stock does not necessarily mean that it is going to be operated at a profit. We have to be governed by the rules which govern every successful merchant. Merchandising is a science, and I do not think anybody should go into it until he has studied the fundamentals of successful merchandising and of the accounting end of it, which is by no means the unimportant end.

Reports

The Secretary's Report

As at former Summer Conventions the Secretary's report again covers the membership of the Association. A further slight increase is shown in the number of Member Utilities. For 1922 we had 132 utilities as members in good standing; for 1923 the total is 134. New Utilities that have been added to our list of members are: Ancaster Township, Delaware, Dorchester, Elwood, Elora, Etobicoke Township, Lambeth, Listowel, Maxville, Toronto Township.

Utilities that were members during 1922 and failed to renew for 1923 are: Alexandria, Arthur, Aylmer, Carleton Place, Otterville, Penetanguishene, Port Dalhousie, Springfield.

In 1922 there were 37 Commercial members; the list for 1923 shows a total of 34, which includes: The Continental Electric Co., Limited; The Masco Co., Limited; The Solex Company, Limited, which companies ask to be admitted to Commercial Membership. The Commercial Membership formerly held by A. H. Winter Joyner, Limited, has been renewed under the name of Powerite Devices, Limited, and that of the Canadian Crocker-Wheeler Co., Limited, has become English Electric Co. of Canada, Limited, which is the controlling company.

Two names are placed before the Association for election as Associates, viz.: J. P. Morgan, C. W. Richardson.

Membership tickets issued for the year 1923 total 595, being distributed as follows:

Class A	205
Class B	205
Commercial	118
Associates	67

All of which is respectfully submitted.

S. R. A. CLEMENT,
Secretary.

Regulations and Standards Committee Report

To The President and Members,
of the Association of Municipal Electrical Utilities of Ontario:

Your Regulations and Standards Committee beg leave to report as follows:

NEW RULES AND REGULATIONS. The new draft that has been in the hands of the Sub-Committee for some time is now about ready for the Main Committee's approval. It was again revised to suit changes being made at the present time in the Board of Fire Underwriters new rules and regulations. This will make both right up to date, and if the new Hydro Electric Power Commission's rules are adopted by the Canadian Electrical Standards Association, and made Dominion-wide by the Federal Government, we will have something that has been long sought for.

The Sub-Committee have done a good deal of work in preparing the draft, and also deserve a good deal of credit for getting the Underwriters rules as well as other provincial rules made as universal as possible.

We also wish to report that a movement is on foot in Toronto to license all electrical contractors and journeymen electricians. This By-law has not yet been passed by the Toronto Council and if it is, it will only apply to Toronto at the present time.

All of which is respectfully submitted.

Signed by the Committee,

JOHN J. HEEG,
Chairman

Minutes of Couvention June 13th., 14th., and 15th., 1923

The Convention was called to order at the Orchard Point Inn, Orillia, Ontario, on Wednesday, June 13th, 1923, at 2 p.m., by the President, A. T. Hicks.

Mr. Tudhope, Mayor of Orillia, gave a short address, welcoming the delegates and extending his wishes for a most satisfactory and one of the most successful of a long series of successful Conventions.

It was moved by Mr. C. A. Walters and seconded by Mr. J. E. B. Phelps: That the minutes of the previous Convention as published be taken as read and adopted, after changing the name of the mover of the resolution to hold this Convention at Orillia from Mr. R. H. Starr to Mr. J. W. Cook.—Carried.

The President, Mr. A. T. Hicks, gave a short address, thanking the Association for having honored him by having elected him to the principal office in the Association.

The Secretary, Mr. S. R. A. Clement, presented his report, which showed a slight increase in the number of member utilities, there being 134 utilities that had renewed or taken out membership for 1923. Commercial memberships totalled 35, which included the following new companies asking for election: The Continental Electric Company Limited; The Masco Company, Limited; The Solex Company, Limited.

The names of J. P. Morgan and C. W. Richardson were placed before the Association for election as Associates.

It was moved by Mr. J. J. Heeg and seconded by Mr. R. H. Staford: That the Secretary's report be adopted and that those mentioned in that report for Commercial Membership and Associates be declared elected.—Carried.

The Treasurer, Mr. G. J. Mickler, reported the Association to have a balance in the bank to date of $1,-769.86.

Mr. J. J. Heeg, Chairman Regulations and Standards Committee, presented a report and moved its adoption, on being seconded by Mr. W. E. Reesor, Mr. Heeg's motion was carried.

Mr. J. E. B. Phelps, Chairman Merchandising Committee, was then asked to present his report. Having been requested by Mr. Phelps to do so, Mr. G. J. Mickler presented the report for him. Discussion following the report on Merchandising was by Messrs. J. E. B. Phelps, O. H. Scott, M. J. McHenry, E. W. Tobin, J. J. Heeg, J. H. Bennett, W. H. Childs, E. R. Smithrim, A. W. J. Stewart, G. W. Blay, R. T. Jeffery, H. D. Rothwell and R. C. McCollum.

It was moved by Mr. J. E. B. Phelps and seconded by Mr. R. H. Martindale: That the report of the Merchandising Committee be adopted and that the members of the Committee who have so freely given of their time and knowledge to the work be given the hearty thanks of the Association.—Carried.

It was moved by Mr. M. J. McHenry and seconded by Mr. O. H. Scott: That Clause 7, Section (a), of the by-laws be amended by inserting "(6) Merchandising Committee" and "(7) Rates Committee."—Carried.

The session adjourned at 5.30 p.m.

At 6.30 p.m. the delegates met for the Convention dinner. Mr. J. C. Miller, of Orillia, acted as toastmaster and introduced Mr. J. P. Downey, ex-M.P., Superintendent of the Ontario Hospital at Orillia, as speaker of the evening. Other speakers were Mayor Tudhope, Mr. Geo. Leacock and Mr. H. G. Farrer, of Campbelltown, New Brunswick.

After the dinner the Orillia Band gave a concert on the hotel lawn.

On Thursday, June 14th, the delegates were the guests of the Orillia Water, Light & Power Commission on a boat trip through Lake Couchiching and the Severn River to the Swift Rapids generating plant.

That evening, beginning at 9.00 o'clock, a convention dance was held.

On Friday, June 15th, the Convention resumed business at 9.30 a.m., when Mr. C. W. Baker, Chief Engineer, Packard Electric Company, Limited, St. Catharines, read a paper on "Transformer Designing." Discussion following this paper was by Messrs, M. J. McHenry, Jos. Showalter, J. H. Caster, Geo. D. Leacock, J. J. Heeg, D. B. Fleming and E. I. Sifton.

It was moved by Mr. F. C. Adsett and seconded by Mr. H. O. Fisk: That a hearty vote of thanks be extended to Mr. Baker for his paper—Carried.

On request of the President, Mr. R. H. Starr introduced Mr. J. E. "Jake" Gaudaur, the champion oarsman, who in a short address extended an invitation to the delegates to

visit his home and see his large collection of trophies.

The Convention then proceeded with that part of the program that had been planned to constitute an afternoon session, and Mr. A. G. Lang, Distribution Engineer, H. E. P. C. of Ontario, gave an illustrated talk on "Underground Construction." Discussion following Mr. Lang's talk was by Messrs. J. R. Smith, H. D Rothwell, W. C. deK. Rogers and J. H. Caster.

It was moved by Mr. J. J. Heeg and duly seconded: That a hearty vote of thanks be extended to Mr. Lang for his talk.—Carried.

The Secretary drew attention to an error in minutes of the previous Convention and to changes to be made in his report due to payments received during the Convention and asked that these be taken care of in the published reports. It was duly moved, seconded and carried that the permission requested be granted.

It was moved by Mr. H. O. Fisk and seconded by Mr. J. J. Heeg: That a hearty vote of thanks be extended to the Orillia Water, Light & Power Commission for the splendid entertainment provided the Association during the Convention. —Carried.

The President extended to the delegates an open invitation to send to the Secretary any suggestions for papers and discussions for future Conventions.

There being no further business, the Convention closed at 12.30 p.m.

The register shows the number of delegates attending the Convention to have been as follows:

Class A	65
Class B	45
Commercial	75
Associates	35
Guests	14
Total	234

There were 205 delegates who attended the Convention dinner.

The Story of the Convention

NEARLY three hundred men and women (chiefly men) gathered from all parts of Ontario to attend the June convention of the Association of Municipal Electrical Utilities of Ontario, which was held at Orchard Point Inn. The convention was the first of its kind to be held at this resort, but now that the facilities for such gatherings is known, it is expected that Orillia will become a popular centre for June meetings of this kind. While all the delegates could not be provided for at the Inn, the overflow found comfortable and convenient accommodation at Lakeview Cottage, Simcoe Lodge and St. Germains.

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To Mr. Frank Gover is due the credit of bringing the convention to Orillia. While attending the convention at Niagara last year, the enterprising Secretary of the Water, Light and Power Commission had

an inspiration, and, off his own bat, invited the delegates to come to Orillia for their next convention. Orillia! Where would they get accommodation at Orillia for such a gathering? But Mr. Gover was confident and persistent, and in the end the Secretary, Mr. Clement, came up to investigate. He was shown over the town, and taken to the Swift Rapids, and on his return made a favourable report. Result, in the end the Executive succumbed to Mr. Gover's importunity, and decided to try a session at Orillia.

* * *

The Secretary of the Orillia Commission now realizes that he got himself, and other people, into a lot of hard work. But he has his reward—and so have they—in the chorus of appreciation from the visitors who were here last week. It began shortly after their arrival, and continued in a steady crescendo until their departure. Perhaps the most appreciative man of all was the Secretary—Mr. Clement. "This is the first convention I ever attended," he declared before leaving, "where I haven't been busy the whole time with local arrangements. This time I have had nothing to do. Everything was arranged in advance."

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Of course, Mr. Gover didn't do the whole thing himself. He had the backing all through of the Commission, chiefly with funds; of Mr. Starr, the Engineer, who called half the delegates by their first names; of the Commission staff, both in town and at the Rapids, who had the whole Orillia system ready for the closest inspection; and of Mr. Therrien and the proprietors of the other resorts. It was a real demonstration of the Orillia spirit—everybody for Orillia.

* * *

The convention opened on Wednesday with a business session, at which Mayor Tudhope gave the civic welcome. Then there was routine business, and at this and other sessions there were three technical papers to be discussed—one dealing with transformers, one with underground construction, and one with merchandising,—all of which were of great interest to the delegates. but not, perhaps, to the general public. This constituted the serious side.

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But at the June convention of the Association social features have a large place, to offset the fact that in January it is nearly all hard work. And it was in this regard that the Orillia convention made its mark. The festivities started on Wednesday evening with a banquet. And what a banquet it was! The delegates declared that never before had they been confronted with such a feast. The basis of the menu was a quarter of a chicken on every plate. But this was only a beginning, though not a few were compelled to cry quits before the end. "I'd like to have seen how many baskets full were gathered up after that meal," remarked one delegate to the PACKET. Mine host Therrien certainly did himself proud, and made a name for the Inn, with that banquet.

But it was not alone for the eatables that this banquet will stand out in the history of the Association. The speaking, too, was voted of an unusually high order. This, also, was provided chiefly by Orillians. John C. Miller was toastmaster. John earned his right to be present by being one of those to pilot Mr. Clement about during his voyage of discovery a year ago, and it is said the good stories he told had a good deal to do with the favourable report. At any rate, he was in good fettle on Wednesday evening, and the way he and J. P. Downey chaffed one another provoked peals of hilarity. Mr. Downey provided the eloquence, and did it with a fervour that quite took away the breath of the audience, just as his acquaintance with the history of electricity surprised them.

* * *

Mr. Downey began by a happy reference to the reputation that Orillia enjoys for hospitality. The stranger within her gates was always welcome, and the Orillia spirit was a happy manifestation of civic pride. Proceeding Mr. Downey made a brief reference to the tremendous progress in electrical development during the past fifty years. He compared the old arc lamp with the sputtering carbons to the steady, high-powered nitrogen-filled lamp of to-day. In transportation we had moved from the early and questioned electrification of terminals and tunnels to the successful operation of trunk lines through their most difficult mountain sections. He compared the 300 ton electric tractor of to-day, running 1,000 miles under occasional examination, with the wood engine of our fathers' time or the highest type of steam engine. In the generation and distribution of electrical energy the development had been startling. From the old style direct current generator to the 55,000 h.p. units installed at Chippawa, was a long step and one that meant the solution of the problem of distributing electrical energy over large areas. Mr. Downey closed his reference to electrical science by paying tribute to Edison and Marconi. In concluding, he touched upon the great opportunities that present themselves to the members of the profession, in this young country with its illimitable resources and possibilities. Canada is still in the making and we, her people, are the architects of her future. If we but do our duty to ourselves Canada's future is secure. "Naught can make us rue, if Canadians to themselves prove true."

* * *

The other speakers were Mayor Tudhope, who again expressed Orillia's pleasure at "showing off" to so many distinguished visitors; and Mr. George Leacock, whom we are at a loss whether to classify as a native son or guest. George, at any rate, used his influence—and it is needless to say he has a host of friends among the electrical men—to have the convention brought to "the old town." Following the banquet the Citizens' Band regaled the visitors with music for an hour.

* * *

Thursday was devoted to a trip to Orillia's power plant at the Swift

Rapids, as guests of the Water, Light and Power Commission. It took two steamers to carry the party—numbering nearly three hundred—the *Geneva,* with a capacity load, and the *Priscilla* likewise. The weather was rather chilly, and a stiff north-east wind seemed to be coming from the ice flows that have lingered in Nottawasaga bay so long this spring. But once into the lower Severn, all this was forgotten, and the visitors applied themselves to enjoying the scenery, and polishing off the luncheon, which made up in quantity what it necessarily lacked in variety.

* * *

The Swift Rapids was reached shortly before one o'clock. Though the party was composed of men familiar with electrical matters, it seemed to be news—and surprising news—to a large proportion of the visitors that Orillia owned the plant, and not the Hydro-Electric Commission. Orillia's unique position in the municipal world doesn't seem to be half so well known as we are apt to imagine. The visitors were more astonished still to find what a fine plant it is, and to learn that Orillia's own load at times uses practically the whole capacity. On Thursday the peak load—20 minutes—was 3,100 k.w., approximately 4,000 h.p. They were loud in their praise, also, of the way the plant is kept. It was all shining in a fresh coat of paint. The Commission had supplied the paint—but the staff at the Rapids had put it on themselves, as their contributions to the preparations.

Aside from inspecting the plant itself, the visitors were entertained to a couple of sights new to the most of them. One was a boat going across the marine railway. The other was a demonstration of "first aid" put on by the staff at the power plant. "Shorty" Mincoff, one of the operators, climbed a pole, shammed a shock, fell limp in his belt was lowered to the ground, resuscitated, and carried away on a stretcher. The whole little play was excellently acted. Mr. Maclachlan, who is in charge of the Hydro's First Aid Department declares there is not a better "crew," in Ontario than that at the Swift Rapids. "I can't teach them any wrinkles," he said on Thursday, as he watched the performance. "Shorty," by the way, who is amphibious, was willing to fall into the river, instead of using his belt, but Mr. Page was afraid that might prove too realistic for the audience.

* * *

At most conventions, the ladies have a rather tame time of it. While the men are busy, they have to sit around and knit—or something of the kind. But the convention last week was different. There was a continuous programme for the ladies, who numbered over a score, as well as the men. On Wednesday, they were entertained to a bridge and afternoon tea at the Couchiching Country Club by Mrs. Tudhope, and the ladies of the Club. This was followed by a drive round town—while the gentlemen were at the banquet. Then on Thursday evening, there was a dance in the hall at Orchard Point Inn—which wasn't

of course, for the ladies alone. In fact, lest they should be overwhelmed, a number of Orillia's fair damsels went over to assist in providing partners for the gentlemen. They danced in such numbers and so vigorously that Mr. Therrien was moved to congratulate himself that he had strengthened the supports under the floor since last summer. The visitors were loud in their praise of Davies' orchestra, and showed their appreciation by repeated encores.

* * *

Nor was it the ladies alone that enjoyed the hospitality of the Golf Club. There were devotees of the game who preferred a day on the links to one on the river—poor fellows! But they evidently enjoyed themselves, and declared they were most grateful. At least, so Mr. T. C. James, Hydro Engineer for this district, told the PACKET. And judging from his toggery, he is quite a golfer.

* * *

One of the sights that naturally interested electrical men was the lighting of Memorial Avenue, with the new "Highway" fixtures. There is only one other place in Ontario where this style of lighting, which has the advantage of giving well distributed illumination, free from the glare so objectionable to motorists, has been installed. That is at Walkerville, where four and a half miles of a lakeside drive has been lighted with this system—and Mr. McHenry, the Manager there, was very proud of being the first, he having had it going for a couple of months. He wouldn't have had that satisfaction if the Government hadn't taken so long to approve the Orillia Commission's plans, which were submitted upwards of a year ago.

* * *

By the way, the Orillia Commission's staff of linemen deserve a word of mention for having this new lighting line ready for the convention. After the approval of the various Departments concerned had been obtained, there was barely time to get the line built. But it was done—though with only a day to spare. They also re-built the line on the Atherley road, besides constructing the new line to Victoria Point. If anybody is under the impression that municipal employees "always loaf," the scoffer should watch Orillia's linemen at their work.

* * *

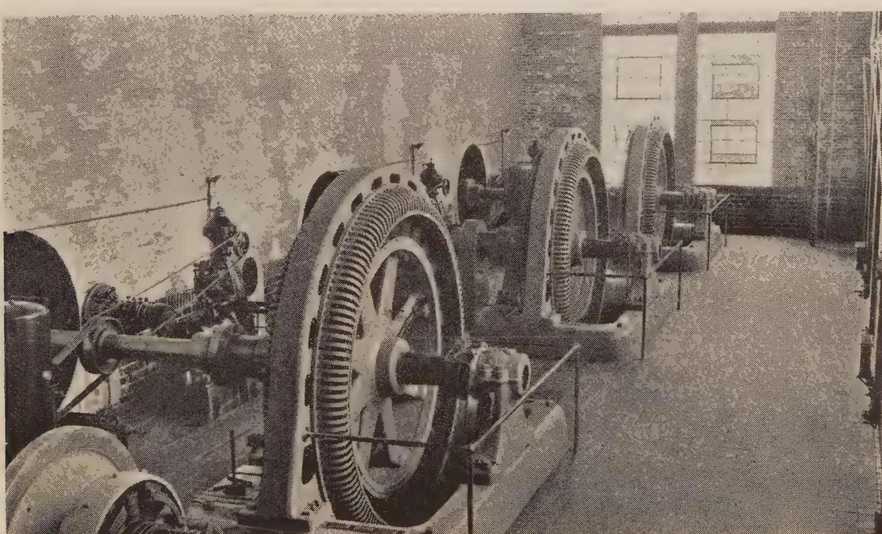
Only one thing made their hosts wonder whether the visitors had really enjoyed Orillia as much as they professed—and that was the haste with which they wound up their business and departed. The convention was to have concluded Friday afternoon, but at the morning session it was suddenly decided to wind up before luncheon, and let the delegates away on the Muskoka express. So when Mayor Tudhope went over to say good-bye, the guests had all flown by train or motor car. Still, considering the nice things they said at that closing session we can scarcely think they left so hurriedly because they didn't like us.

One pleasant incident of the morning session was a visit from "Jake" Gaudaur. When President Hicks, of Oshawa, learned that the ex-world's champion lived next door, nothing would do but he must come over and be introduced. Jake doesn't make much of a lion. He won't roar. But the visitors were evidently glad to see him—in fact were proud of meeting so famous a Canadian. Incidentally a good many dropped in at Jake's home to see his trophies, and were given a hearty welcome. Another of Orillia's world champions, Walter Knox, was to have been presented at the afternoon session, which didn't come off.

A list of the delegates wouldn't convey much to PACKET readers. Suffice it to say that they came from Ottawa and Belleville on the east to Windsor, Owen Sound and Kitchener on the west, and included many men of renown in electrical circles. Numbers came from nearer home—eight, for instance, from Collingwood, including Mayor Arthur and Police Magistrate Hogg.

* * *

And so ended the first big convention at Orchard Point Inn. But. let us not hope, by no means, the last.—The Orillia Packet.



Generator Room, Swift Rapids Development.

Rural Distribution Systems

By A. G. LANG

Distribution Engineer, H.E.P.C. of Ontario.

THE rural distributing circuit is carried on the poles of the urban system from the sub-station to the urban limits. From this point the construction is of a strictly rural type, as specified in detail hereinafter, excepting only that use is made of the poles of suitable existing lines such as those carrying the high tension circuit to the sub-station, whenever such lines are available.

Where the number of consumers is small, it may be advisable to extend the urban circuit rather than to construct a separate feeder from the sub-station.

The standard circuit for primary distribution is 2,300-volts, single phase with one leg of the circuit grounded. At or near the consumer's premises this is stepped down by a service transformer to 220 or 110 volts, single phase.

Usually for economy in distribution, the circuit is made 3-phase 4,000/2,300-volts, from the sub-station to a load centre in the district, and numerous branch lines of single phase, 2,300-volt circuit are tapped off from the 3-phase circuit. The single phase circuits constitute by far the greater mileage and the standard service given to the consumer is single phase; 3-phase service is given only to consumers with exceptionally large loads.

On account of the small load den-

Telephone Lines and Trees, forcing use of Underground Construction.

Underground Construction used on account of Trees.

sity per unit length of line, it is necessary to install a type of construction of low capital cost in order to reduce the cost of power to a point at which it will be attractive to the rural consumers. At the same time, the rural consumers will not be content with a quality of service in operation inferior to that supplied in urban municipalities.

To obtain minimum costs, local labor is used wherever such can be secured and occasionally poles are obtainable in the vicinity. On practically all proposed lines tenders are obtained, and if satisfactory offers are received the work is done by contract.

In making a survey for the location of a line along a rural highway, it will usually be found that a telephone line is already occupying one side of the highway; and as might be expected, this line occupies the most desirable location, even to the extent of jogging across the road at intervals to avoid trees. The second choice of location must then be accepted. Frequently, however, two lines of telephone poles, one on either side of the road, will be encountered, necessitating either the overbuilding of one of the telephone lines by the power line or an arrangement for joint use of poles for the telephone and power circuits.

For overhead lines, the standard pole used to carry the 4,000 or 2,300-volt circuits is 30 feet in length, Eastern Cedar, with 6 inch diameter at the top. These poles are set in the ground to a depth of 5 feet, 6 in. Poles of greater height are occasionally required to provide clearance

from trees and foreign pole lines. At railway crossings poles of top diameter not less than seven inches are necessary and of sufficient height to permit a clearance of 30 feet between the rails and the conductors for the 2,300-volt circuit.

The maximum spacing between poles on the rural power line is 160 feet and this spacing is commonly obtained, but it is reduced at curves in the road and at corners, and by other obstacles, so that the average spacing may be considerably less than 160 feet.

The standard conductor is No. 6 B & S gauge bare hard drawn copper for the 4,000 and 2,300-volt circuits. For the 4,000/2,300-volt, 3-phase circuit the conductors are supported on 4 pin dressed fir cross arms of cross-section 3-3/4 by 4-3/4 inches and 6 feet 4 inches in length. This length provides a climbing space of 30 inches with 18 inches between the outer and adjacent conductors. The cross-arm is secured to the pole by a 5/8-inch machine bolt and by two flat steel braces 30 inches in length. All hardware is galvanized.

Cross-arms are not used for the 2,300-volt, single phase circuit, the phase or ungrounded conductor being carried on a steel pin projecting above the top of the pole and the grounded conductor on steel bracket on the side of the pole with two feet vertical separation between the two conductors.

Porcelain insulators are used for all wires of the primary circuit excepting the grounded conductor for which glass insulators are used.

Accident to overhead system, due to sleet storm.

Opening trench for Underground line.

Service transformers are identical with those used in urban systems, except that a low exciting current is essential, as for rural districts, the ratio of demand on the feeder to connected kv.a. in transformers is very low.

Isolated transformers are the rule, i.e., one transformer for each consumer. In hamlets, however, and wherever farm services are close together, one transformer is arranged to feed as far as is economical over the 220 or 110 volt secondary circuit.

In 1921, due to the great increase in cost of labor and material, which made itself evident in this as in other classes of construction, the Commission's engineers investigated the possibilities of underground construction in rural districts. The use of cables laid underground is of course a well established practice and in fact antedated the use of pole lines. The application of underground cables to the rural service is, however, quite new, and the methods of installation and the details of design were given considerable study. To date a total length of 150 miles of cable has been laid underground and is operating successfully.

The standard cable is briefly described as follows:

Single conductor, No. 6 B. & S. gauge, 7 strand copper, insulated with 30% para rubber 3/32 inch in thickness, laid over with a rubber filled insulating tape and covered overall with a pure lead sheath, 1/16 inch thick.

This cable is furnished in uniform lengths of 1/3 mile each.

The cable is laid in a trench at a depth of from 12 to 18 inches and is not protected by a duct or covering other than the re-filled soil, except at hazardous locations such as road crossings, where a creosoted plank is placed above the cable after a few inches of the excavated soil has been re-filled.

The trench is made by a grading plough, of exceptional strength, drawn by a caterpillar tractor. The plough is designed to turn a furrow 18 inches in depth. It is fitted with a heavy coulter which readily cuts through tree roots 4 inches in diameter.

Back filling trench, Rural Underground System.

The tractor is also used to draw a carriage on which the cable reel is mounted and from which the cable is laid in the trench with a minimum of handling. The tractor is also used to draw a scraper for re-filling the trench.

Cable joints are enclosed in lead sleeves, compound filled, and sealed with wiped joints to the cable sheath.

At points where service to consumer is required, a wood pole is set and the cable is carried up the pole, terminating in a disconnecting pothead; continuing the circuit along the highway, the cable is carried down the pole again from a second pothead. This method eliminates the necessity of a joint at the foot of the pole and the disconnecting potheads form a convenient means of opening the circuit for test or other purposes.

The potheads are installed with wiped joints. The cable on the side of the pole is protected by a metal moulding. On this pole the service transformer is mounted and the secondary service wires are usually run overhead to the consumer's premises.

In operation the cable, up to this date, has proved quite satisfactory. Occasional faults have developed but comparatively few considering

Underground Cable Marker.

the total mileage in operation. Novel methods have been devised for finding faults and the locating and repair of same is now accomplished quickly and satisfactorily.

It should be stated that this type of construction is not expected to supplant entirely the use of overhead construction, and the local conditions will govern the decision in making a choice between the two types.

Under conditions favorable to the installation of the cable the capital cost per mile will be less than for an overhead line. This applies to single phase circuits only, where in general the lead sheath is used as the grounded conductor of the circuit. Excepting under conditions extremely unfavorable to overhead construction the cost of laying 3-phase circuits underground will exceed the cost of similar circuit overhead.

It is expected, however, that the cost of maintenance and operation and the rate of depreciation will be decidedly in favor of the underground system.

The underground system is proving very popular by reason of the elimination of unsightly wood pole lines from the highways, the avoidance of the necessity of cutting shade trees and the satisfactory operation during storms when overhead lines may occasionally be out of commission for considerable periods.

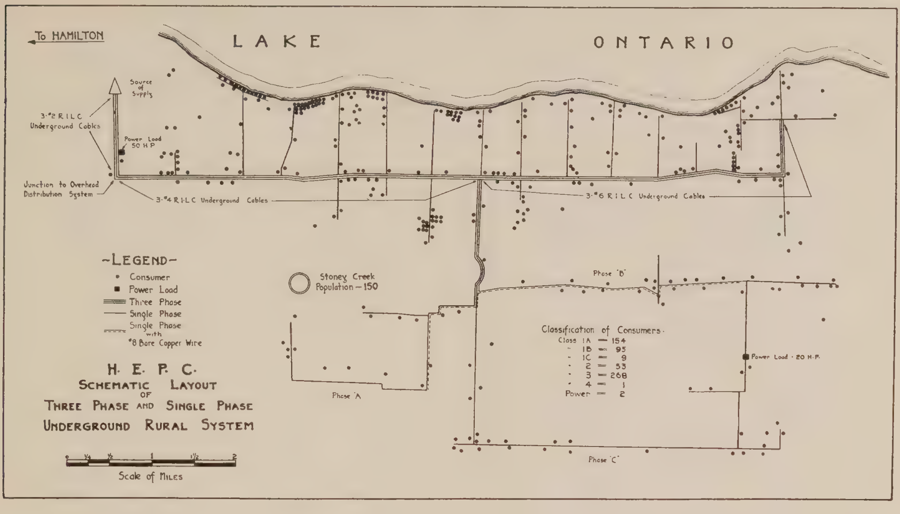
Typical Service Loop and Transformer Installation, Underground System.

The Earthed Return

IN our last issue we gave some particulars of the use of lead-covered underground cable for the distribution of electricity in rural areas, by the Hydro-Electric Power Commission of Ontario; the cable, of which 150 miles has been laid, is unarmoured and is laid directly in the ground without protection, and the lead sheathing is used as the return conductor. We learn with interest from Mr. A. Hugh Seabrook, of Messrs. Sir Charles Bright and Partners, Ltd., that his firm is adopting a similar plan in connection with the distributing system of the Swanage Electricity Co., Ltd. The high-pressure single cables, working at 2,500-volts a.c., and the low-pressure cables, at 240 volts, will be "single-pole" unarmoured, with the outer conductor (i.e., the lead sheathing) earthed. A proportion of concentric cable is also scheduled in the specifications for use in the towns and villages, but with this we are not concerned.

Why is the earthed-return system so little used in this country nowadays? We remember a time when concentric earthed-return indoor wiring was strongly advocated, and several ingenious systems were elaborated, some of which are still on the market. The Institution Wiring Rules offer no obstacle to the adoption of earthed concentric wiring

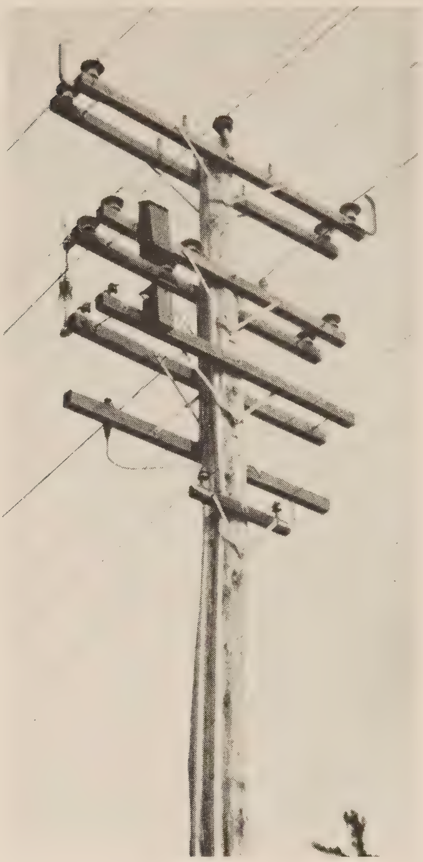
Typical Rural Service from Underground System.



Schemic Layout, Saltfeet System.

and of course the earthed-return system is very widely used on board ship, but on land it is necessarily restricted to isolated installations unless a double-wound transformer is provided.

The more important matter, however, is the use of the earthed return for rural transmission lines, whether overhead or underground. In the latter case, assuming that all the current returns by the lead sheathing, the drop of pressure therein will be about the same as in the copper conductor in the case of small cables of ordinary construction (say, 0.01 sq. in.), but in larger sizes it will be much greater (about five times in the case of a 0.1 sq. in. cable). Hence, as the thickness of the sheathing of the larger cables could not economically be increased sufficiently to give a reasonable drop, either it must be reinforced with a copper conductor or steps must be taken to ensure that the conductance of the earth is utilized, by providing earth plates at suitable points. Some years ago Mr. J. S. Highfield, when laying out the high-pressure direct-current system by which supply is given from Willesden to Southall, in the western area of the Metropolitan Electric Supply Co., made an elaborate series of experiments on the use of the earth as a return conductor, with a view to employing it as a stand-by in the event of breakdown of a cable; the results were included in a paper read before the Institution of Electrical Engineers, and recorded in our issue of June 21st, 1912, and they clearly show that an earth resistance as low as one ohm can be readily obtained. The only questions remaining to be considered are those of electrolysis and interference with telegraphs. With alternating current the former is practically negligible; with regard to the latter, in rural districts the



4,000 volt Rural line carried on 13,200 volt pole showing tap to 2,300 volt Underground feeder.

telegraph and telephone lines are not numerous, but the possible effect upon them must be considered. However, Mr. Highfield stated (loc. cit) that Post Office engineers had found a potential difference of only 1.4 volts between Southall and Willesden, a distance of seven miles, when a direct current of 90 amperes was flowing. Moreover, experience gained with the use of the earthed return for tramways, and in some cases for railways, during the last quarter of a century, with a direct-current drop in the earth limited by the Board of Trade regulations to a maximum of seven volts, has abundantly proved that where suitable precautions are observed neither electrolysis nor interference with telegraphs need be feared.

There appears therefore to be no good reason to forgo the use of the earth as a conductor under the conditions here referred to, and obviously great economies can be effected thereby; for one thing, there is only one insulated conductor, so that failures should be minimised—the earth won't break down. The cable itself costs less, joints are more easily made and more reliable, the cost of services is reduced, and the liability to interruption of supply is diminished. By dispensing with the use of armour a further economy is effected, amounting to no less than 40 per cent. in the case of the smaller cables; the value of armouring as a protection is highly problematical, and one important undertaking has used plain lead-sheathed cable for years, with satisfactory results. The attitude of the electricity Commissioners and the Postmaster-General towards the method must be taken into account, but whilst the Board of Trade would probably have demurred in these days such questions are decided by engineers on technical and not on political grounds. We think, therefore, that the lead which Mr. Seabrook has given in this country should be closely watched with a view to following his example in other rural districts.

Incidentally, Mr. Seabrook is

specifying for single phase integrating ampere-hour meters for Swanage—in accordance with the views which he expressed in our "Correspondence" columns not long ago. —The Electrical Review.

Should Central Stations Merchandise?

By A. W. KRUEGER

Edison Electrical Appliance Co., Chicago.

SHOULD the central-station company sell appliances? Our experience permits only one answer: "Yes—most emphatically." Everybody benefits through central-station appliance selling activity. The reasons for this are readily apparent.

Let us take the consumer. Not nearly the number of women to-day would know of and enjoy the benefits of electrical household devices had central stations remained inactive or indifferent to their educational responsibilities. Most of them would still be pushing a broom over their carpets instead of using a vacuum cleaner and realizing its tremendous labor saving. In most cases they would still be turning a flywheel on the family washing machine. They would not be enjoying the advantages of electrical cookery and many other similar benefits.

This one constructive factor in itself is sufficient reason for the central station to merchandise appliances, because by so helping their customers they render a real service as a public utility through bringing the public to a realization that electrical service only starts with lighting. Helping to educate the public, the central station benefits not merely through good will but very materially in dollars and cents because of increasing the energy day load, most of which is consumed at the lighting rate. In addition, nearly all central stations which sell appliances to-day are receiving from their commercial departments a merchandising profit.

The story of these benefits does not stop here. The widespread public acceptance of electrical appliances has automatically created thousands of electrical appliance dealers. They effectively supplement central-station activity. Their success means additional central-station day-load revenue. They are a valuable asset in broadening the appliance field and are well worth the closest cultivation and co-operation.

Merchandising Progress Gradual

In the early days of central-station merchandising thousands of flatirons were distributed at cost. In a great many cases they were actually given away. It was good business then because the increased

day load more than offset the expense involved. The public began to realize the labor-saving advantages of electrical household devices. They began to appreciate that electrical service meant something beyond lighting bulbs. This, however, was not conducive to dealer expansion, for they could not compete. The practice was relatively short-lived because it was soon found that the public responded to intensive campaigning and people were ready and willing to pay reasonable prices for electrical conveniences. Central stations abandoned the earlier plan of no merchandising profit and put their individual commercial department on a profit-producing basis. They realized the advantage to themselves as well as to the dealer of the active co-operation of all electrical appliance selling outlets, such as electric specialty shops, hardware stores, department stores and electrical contractors—in fact, every legitimate merchandising outlet for household devices. Manufacturers' suggested list prices were maintained, and an extremely healthy condition resulted—a condition that holds true to-day in virtually all communities.

It is unfortunate that there are to-day some dealers who still carry the point of view that the game is one-sided in favor of central stations. They have not stopped to analyze the facts of the case. A great deal of progress has been made in educating the dealer and making him a better merchant, but there is still room for a lot more good work that can be promoted by the central station to produce more harmonious relations between these branches of the industry.

George A. Hughes once declared: "Show me an inactive central station and I will show you a dead appliance town." This statement clearly defines the facts. Consider a concrete case, that of a busy mid-western city with a population of 250,000 inhabitants. Up to a few years ago the policy of the local utility was to sell energy and lamps only. "Leave it to the dealer," was its motto. Did the dealers appreciate this situation? Did they get busy and make the most of their opportunity? Did they advertise on billboards? Advertise in the newspapers? Conduct demonstrations? Circularize their mailing lists? Did they ever make an appliance analysis of the town? Not so you could notice it! They sat back and wondered why their appliance business was not better.

Utility A Gage of Activity

The central station in question finally came to a realization of this condition. It decided to get busy and to become an active merchandiser and it believed in "doing the job up brown." A location was secured in the heart of the shopping district. No expense was spared in fitting out the display room as the outstanding appliance showplace of the city. Neither was any money spared in widely advertising that fact. A tremendous howl went up from the dealers. Appliance business was going to be ruined! The central station would wreck the whole merchandising

works. It would kill what little had been accomplished.

What actually happened? The town just began to wake up to the value of appliances. Nobody had ever taken the trouble to tell it the real story before. The central station used billboards, newspapers, sales letters, attractive windows and freely advertised the appliance shop. The public's interest was aroused. People were soon thoroughly "sold" on the electrical household idea. Appliance sales increased by leaps and bounds. Dealers who had bitterly fought the movement sold more appliances than they ever dreamed was possible. Department stores opened special electrical departments. Electrical specialty shops with high-grade equipment and merchandise sprang into being. Hardware stores got busy. Everybody was benefited. Even the dealers admitted that. Had the central-station company not changed from a passive to an aggressive merchandising policy, that city to-day would still be plodding along in the same old way.

There are a few exceptions, of course, where, for instance, the central station does not actually sell merchandise, but where it does actively co-operate with the dealers through showroom and window displays, billboards, newspaper advertising and special electrical shows. These cases, however, are exceptions to the general rule. Selling merchandise at cost has been proved unnecessary. Both merchandise and energy profit can be produced at the same time. Maintaining list prices puts everybody on an equal footing. The more everybody sells, the more the central station benefits; the more everybody sells.

Another concrete example of the result of central-station inactivity is the experience, some years back, of our company. Our selling records included a comprehensive map tack-system. A black tack was placed on every town showing the location of our dealers, which in those days reflected the town's appliance activities in a large sense. The map was pretty well covered throughout the state with the exception of an area in central California that was practically barren of dealers. An investigation easily revealed the fundamental cause — central station passiveness and inactivity. The public was not "sold" on the electrical household idea. It was surprising to note how quickly this condition changed when these central stations interested themselves in appliance merchandising. The barren area filled up rapidly with tacks as new dealers sprang into existence.

Almost every central station maintains an office with a large amount of display room available. In the majority of cases they are active merchandisers. Great numbers of people come into their offices during the month to pay their bills. Aside from other considerations, this puts the central station in a very favorable position to merchandise which is not enjoyed by the majority of other classes of merchants. It is good business from every angle because the display room can be made to pay overhead

and show a profit. How could we answer the question of "Should central stations sell appliances?" with anything but "Yes"? We believe that individual experience will justify this answer.—Electrical World.

Selling Ourselves

It is generally agreed that the electrical man himself has been about the hardest "prospect" to interest in the use of electrical appliances in his own home. Theoretically he has believed in them from the beginning, but he has thought about them and supported them mainly during business hours. He has not tried very hard to "sell" his wife on the daily use of electricity for saving labor, and the electrical equipment of the electrical man's home has never been a beacon to the community. The action of the New York Electrical League in holding a contest among its members to determine whose house is the most completely electrified is, therefore, worthy of attention. It offers a basis for developing interest and rivalry between the men and women of any electrical group or within any electrical organization that is bound to stimulate acceptance of the responsibility which all electrical people should feel to set an example to the public in the enjoyment of and dependence upon the good things which electric service offers in the home to-day.

The idea was born on the special car that carried the delegates west to the N.E.L.A. Commercial Section meetings in Denver some months ago, and the "Electrify Club" was formed as an informal organization to promote contests among electrical men and bring publicity to those whose homes are well equipped. Prizes are awarded by rating houses on a point system, crediting each type of outlet and appliance, and the plan offers a spectacular demonstration of the degree to which comfort and convenience can be introduced into the modern home—electrically. Here is an idea that can profitably be furthered by the central-station company in every community.

—Electrical World.

Hydro Generators Caught in Electric Surge—Repair Crew From Belleville Showed Efficiency

Damage to Hydro power property in this city by last night's severe electric storm demonstrated the efficiency and promptness of the Commission's repair staff in this district.

As soon as the Auburn power plant and also the sub-station on Simcoe Street, which provides the current for Peterborough's street railway, were hit, a message was flashed to Belleville, the headquarters of the Hydro-Electric Commission in Central Ontario.

Immediately several experts in generator repair work, meters, and other electric branches, together with experienced and capable handy men for the heavy labor, were des-

patched to Peterborough, drove through part of the storm, worked all night, and this morning before noon rested on the results of their urgent toil.

A new machine had been put into service in the sub-station on Simcoe Street, one of the generators at the Auburn was again operating, leaving the third, which is also a spare, for attention under less pressure.

A switch controlling a transformer was also damaged at the Auburn station, but the damage was reduced to a minimum by the fearlessness and fidelity of the operators in charge. When the surge of lightning swept into the power house and flamed with a roar above the machinery, cables caught fire and might have been put out of commission with heavy financial loss but for the prompt work of the plant employee, who, with a pyrene extinguisher kept the burst of flame on the cables to a small spot, and thus quickly extinguished it.

"Not all the heroes are in the Army and Navy," said The Examiner's informant, who believed that the average layman would be helpless with fright at the noise of the pyrotechnics of a power plant in the line of an electric storm.

The city's distributing system escaped with only minor damage.

"We're shaking hands with ourselves," said H. O. Fisk, manager of the Utilities Commission, to The Examiner. "A couple of fuses were knocked out, but that was all."

It was reported last night that a generator was also damaged at the Healey Falls power house, and when the storm was at its height yesterday evening the circuit was opened as a safeguard, and the power was not turned on again until 8.15 o'clock.

The Hydro obtained some power from the Quaker Oats Company last night, but the heavy rains of late and the large volume of water flowing in the river made up for any slight temporary deficiency in the Hydro's power supply.—Peterboro Examiner.

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AUGUST, 1923

Hydro In New Hamburg

THE village of New Hamburg is one of the pioneers in receiving electrical power through the Hydro-Electric Power Commission of Ontario and holds the distinction of being the first municipality to vote on and carry the By-Laws enabling it to obtain power from Niagara Falls. It was also one of the original fourteen municipalities that signed the agreement of May 4th, 1908.

New Hamburg also holds the distinction of being the first municipality in the Niagara district to receive power from the Hydro-Electric Power Commission. The first delivery was made to New Hamburg on February 3, 1910, the power being obtained by the Commission from the Kitchener (then Berlin) steam generating plant. The service was continued from this source until the first delivery was made from Niagara Falls in October of that year, when New Hamburg became one of the first to be supplied from this latter source. Since that time New Hamburg has continued to use electrical power transmitted from Niagara Falls only.

The electricity is received from the Kitchener transformer station at 13,200 volts, and is stepped down at the municipality to 2,200 volts for distribution. The municipal sub-station is equipped with 3-75 kv-a.

Packard transformers. The service transformers for domestic and commercial lighting service are all connected 3 wire 110/220 volts. All new secondary mains are either No. 00, No. 0, No. 2 or No. 4; there is no wire smaller than No. 6 used anywhere in the municipal distributing system. The system at present serves the following, the village having a population of 1,400:—

Domestic Consumers	263
Commercial Consumers	78
Power Consumers	12
Streets Lights,	
100 watt multiple	220

The power consumers have a total of 280 h.p. installed for industrial purposes. Among the domestic consumers there are 68 electric ranges and hot plates in use. The average cost of operating an electric range together with the lighting and other appliances in the house is $3.50 per month; the average yearly bill for domestic service is $22.00.

Since the beginning of operation the electrical department has shown a surplus of revenues over expenses in each year. The assets have nearly doubled while the liabilities at the end of 1922 amounted to only 35 percent of the assets. Although the rates for electric service have been reduced on four separate occasions, yet the surpluses created each year and applied to the cost of extending and improving the system has created this very desirable condition. Prior to Hydro the net rate for lighting was 10 cents per kilowatt hour. Since that time the average rate for domestic service has reduced year by year to 3.32 cents per kilowatt hour, and for commercial service to 3.71 cents. During the same period the average monthly consumption per consumer has increased by about 200 percent.

The municipal system is operated by Superintendent George Morley and Secretary J. F. Katzenmeier, who have served since the beginning of the service. In his 12 years of service, Superintendent Morley, who alone reads all of the meters each month has a record of there being only one month in which he was unable to attend to his various duties on account of sickness.

Ice Conditions on the St. Lawrence River

THE picture shown on the front cover, and also that following, are from photographs of ice conditions on the St. Lawrence River during the ice jam of March, 1923. The photographs were taken below Morrisburg, looking across the head of Gooseneck Island, south to the New York side of the river. They illustrate the building up of these ice jams once there is provided a fixed point from which they may start. The foundation is provided by the release from large bays of fields of heavy surface ice, which cannot be disposed of by the open channel. On this is packed the smaller floating ice delivered continuously in varying quantities until the jam extends back for many miles.

This condition is not a yearly occurrence but recurs after a considerable time. The last time a similar condition existed in this part of the St. Lawrence was in 1905; before that it was in 1887, showing a period of eighteen years between each jam.

The running of the ice at the head of the jam is an interesting sight. The current plays with the larger blocks of ice, tossing them about and causing them to float down in very peculiar positions.

The development of power along this stretch of the river will do away with the inconveniences resulting from these jams.

The Essence of Public Relations

THE attitude of the electric utility towards the public is a subject causing much thought, and a great many suggestions have been offered for its improvement. The impression created by the utility officials with whom the public deals counts for a great deal, but the actual result of a visit is the most important factor.

The following extract from the Electrical World refers to a report outlining the system used by an electric utility whereby the average time of making service connections was less than three hours from the time when the application was received. There is a standard that any utility would be proud of.

Here is a healthful message for all utility executives. It comes from the heart of an American citizen—a householder, a consumer, a customer, one of those buyers of service and securities who regulate and in the last analysis own all public utilities. It is for this man and others like him that public service corporations are operated. He writes:

What better advertising matter could the Chamber of Commerce of Syracuse have than a reprint of the article in the April 14 issue of the Electrical World describing the wonderful service rendered by the Syracuse Lighting Company? If any other large lighting companies in this country are giving service that in any way approaches that of the Syracuse Company, please print a few more stories about them. Give them your front-page editorial space. They have earned it. Perhaps if a few of these stories appeared some of the other central stations in the country would wake up enough to be ashamed of their methods and would reform.

I was once with one of the largest managing organizations of this country. I know the problem from the inside.

And let me say right here that I do not believe that the problem is one bit harder than the sales problems of large non-public utility organizations. My sympathy has always been for the utility, but I confess that it is waning for one utility whose annual output ranks high in your recent list. Here is the way that utility does it:

On rather short notice I found it necessary to change my apartment. I went to the main office of the lighting company to request the change. Before me was a sign telling all comers that the business of the company is service. I waited twenty-five minutes in front of my sign-greeting. This time was not all wasted because I was entertained by the troubles of others. I could hear only the eight directly in front of me. Three of these eight came about new problems. Five had complaints.

When my turn came I was instructed where to sign and told that accedance to my desire to have the service changed in one week was rather doubtful as the company required a ten day notice and in addition this was its busy season. I was assured, however, that the matter would have the company's best attention. While I waited the locations were looked up, verified, and, as if to cheer me up, I was told that my move was to a new apartment and that a permit for connection had been issued to cover the entire building. My impatience at waiting had subsided, and I went away feeling that the company had a large problem on its hands and that I really might have service in a week instead of ten days.

Moving day arrived. No electric service. A telephone call gave me the information that no permit had been issued. No arguing on my part about the casual remark made at the main office on this subject when I applied for the change was of avail. What was I to do? Oh, I could call the main office and tell them they were all wrong on the permit stuff, or I could get the owner of the apartment to get after the town wire inspector.

I called the town wire inspector myself, and he told me that he would issue a permit any time the lighting company requested it. He had inspected the building but only issued service connection permits when the lighting company requested them for each apartment.

Another call to the lighting company. They agreed to connect. When? Tomorrow, perhaps; no connections were made in that town on Tuesdays. Result, I go to the corner store and buy my candles, and forever and a day—try as I will to forget this petty incident—I will just naturally feel that the company cares not for its customers and that I must do my part as a loyal citizen to oppose any rate increases.

Perhaps I had better take an active part in the local movement to require the lighting company to place all of its wires on the main streets underground. No, I am not a grouch by nature, so I am going up to the gas office to smoke a cigar with the manager. He changed my service on the day I wanted it changed and did it all by telephone request. But, then, the gas company only serves a territory of thirty thousand people and the lighting company serves one of over a million. Perhaps that is why the gas company is still a he while the lighting company is they.

Pictured in this letter we have the very essence of public relations—that thing in which the industry is so absorbed to-day. It seems a small matter from within —the coming of a stranger to the application window. But these are the contacts of which good will is builded, the elements in service which make the central station and its manager well and favorably known—or not.

Public Relations--Close Up

THE topic upon everybody's tongue at the great convention in New York was public relations. Public utility men, central-station executives were all talking about it. The problem of serving the public heartily and of intelligently interpreting this service to the public received the most conspicuous attention.

Public relations has come to be a very big thing in the light and power business. But really public relations is not one big thing at all. It is a very great many little things.

Out in Omaha, as an example, the Nebraska Power Company believes that the secret of public relations is to take care of customers when they are in trouble. And so it maintains a staff of motorcycle men to answer trouble calls, just as many other companies do. But as Vice-President J. E. Davidson puts it: "It isn't so much what you do as the way the thing is done that registers with the public." Therefore the Omaha company has made it the objective in these trouble calls not only to go and straighten out the troubles but to surprise and please the customer with the spirit of the service.

A telephone call comes to the Nebraska Power Company's switchboard. Mrs. Ray is giving a party and the lights have gone out. "I'm awfully sorry!" says the girl; "I'll send a man at once"—a sympathetic and personal response.

The two best troublemen are on duty at night, so placed and trained that any residence in town can be reached within ten minutes. In five minutes perhaps a motorcycle thunders up, the doorbell rings, and the Nebraska Power man is there, expresses sympathy, renews the fuse, asks if there is anything else that he can do and leaves.

He makes the same fast time back to his post and reports to the switchboard girl. In say, about eight minutes after Mrs. Ray has thanked him and closed the door her telephone rings. It's the Nebraska Power girl, still much concerned. "Has our man arrived? He has? I'm so glad! Is everything all right? Can we do anything more?" In short, within, say, twenty minutes the man has come and gone and all is well and a sweet voice from the company has followed up, full of concern. And every call makes one more friend.

Success in building up good public relations is the good relationship between the individual representatives of the company and the individual customers. But we, the public utility employees, are naturally absorbed in our own work and apt to be forgetful of these little incidental courtesies. And we, the people, are no less absorbed in our own affairs and apt to accept these services as a matter of course and also to be supercritical. The maintenance of harmony in all these contacts is therefore not only

an important but a very difficult responsibility.

Public relations everywhere and every day depend on putting extraordinary heartiness and helpfulness into the ordinary human intercourse between all the men and women of the company and all the men and women of the city. It is not done, it never will be done, unless the chief executive of the utility makes it his own concern and leads and guides in both the planning and the performance of it.

—Electrical World.

Conditions Which Delay Prompt Service Connections

By J. B. REBUS

Assistant General Manager, Harrisburg (Pa.) Light and Power Co.

ARTICLES appearing recently in the Electrical World showing the time required to give service after application has been made are of more than passing interest. They indicate thinking along the right lines, and this will result to the advantage of the utility companies. These articles have been read by a great many executives, officials, operating-department heads and employees of utility companies. They have, no doubt, also been read by consulting engineers, manufacturers of electrical equipment, electrical dealers and contractors. It would be surprising indeed if it had not occurred to a number that similar data should be compared for a period sufficient to show the average time applicants have waited for electric light or power service after application has been made.

A great deal of educational work has been done in past years by utility companies to bring the prospective consumer to consider and decide upon the use of central-station service at the earliest possible moment. In many instances, during the option period in the purchase of property, before the final transaction has been closed, if electric service is not available at the location, it is necessary to ascertain whether the utility will make the necessary extension, in order that the service shall be available when the prospective customer's construction is completed. This is an established practice among utilities and it has proved to be in the interest of both the company and prospective consumer. Comparisons, therefore, based upon the actual elapsed time between the signing of the application and the starting of service, should in such cases include the time necessary for the construction of overhead or underground extensions and the installation of the service connection from the main to the consumer's property, the time to obtain

the necessary permits, insurance inspection and other requirements, as well as sometimes unavoidable delay in shipping material for such work.

Application for service must be made when convenient for the applicant, which, whether by telephone or upon call of solicitor or at the company's office, may be just before closing time on a day before a holiday or Sunday, or when a holiday immediately precedes or immediately follows a Sunday, thus greatly increasing the time between the application and the starting of the service, for it is unavoidable, that the applicant shall be without electric service during that period.

For a period covering one year from May 1, 1922, to April 30, 1923, the Harrisburg Light & Power Company received and executed 1,540 applications for service where it was only necessary to set a meter. There were 3,154 applications for service where the meter was already installed and the service available for use. There were also 2,206 applications for service where it was necessary to make extensions of underground mains or of overhead distribution system, to construct an underground service connection from the main to the consumer's property or to run the service from the overhead-main extension to the consumer's property and install a meter. The territory served by the company is 17 miles long by 6 miles wide with a number of rural lines and considerable construction on farms or property of the applicants. In several instances during this period applications for power service were made where from two months to nearly a year was required for the applicant to make his own construction before service was started. The elapsed time which has been used in compiling these data includes all such periods.

Some time ago the company put into effect, for experiment, the plan of leaving the meters installed when customers discontinued the use of service. The main switch was opened and the handle secured by a meter seal. A colored card was attached to the bottom of the hall chandelier or other place in the main entrance where it could not but be seen stating that the service was available on the premises by closing the entrance switch and telephoning the company that service was to be used. The result of the experiment exceeded the expectations of the meter department, where the plan originated. The reduction in the work which would have been necessary by the meter department had these meters been removed made it possible to postpone taking on an additional employee. Not only was this saving made, but additional revenue was realized because of the service being available and used earlier than would have been possible had the meter been removed. Since this plan was first tried no loss has been suffered by failure of applicants to pay for the service, and the plan has been permanently put in effect.

During this period 1,540 applications required setting of meters, and the elapsed time for signing the application to the time of starting service was 134,722 hours. For the 3,154 applications for service where the meter

was already set and the prospective applicants started to use the service no elapsed time occurred. This means that 3,154 of 6,900 applicants had no delay in securing service. The 2,206 applications for service where extensions of underground or overhead system including running service and construction of sub-station on customer's premises, were necessary required 798,112 hours.

These results may appear unfavorable as compared with the very short periods required by some utility companies, but they show how conditions created by the customer and over which the company has no control sometimes affect the length of time intervening between the service application and actual connection.

Customers as a rule appreciate prompt service and attention to their requirements, even though they do not always so express themselves to the company.

—Electrical World.

Re-Installation of Electric Water Heaters

July 31, 1923.

To Editor of the Hydro Bulletin.

From the discussion recorded in the July issue it would appear that a great deal of difficulty has been experienced in having cold water flow up through an electric heater rather than obtaining water already heated from the tank.

One condition which will give rise to this is an incorrect connection of the T-coupling leading from the tank and the heater to the hot-water tap. This coupling should be so inserted that the straight line flow of water would be from the tank to the tap and the heater should be connected to the branch side of the T-coupling.

The selection as to whether water from the incoming lines will flow through the heater or through the tank depends on the small difference in pressure head set up by the rise in temperature of the water and on the resistance to flow offered by the respective channels. Since the difference in the pressure which gives this selection is very small some better degree of control is afforded by making the channel through the heater more tortuous than that through the tank to the tap. Mr. J. J. Heeg, (loc. cit. p.225) accomplishes the same result in another way but the principle of operation is not essentially different. We would not anticipate trouble in the selective action of the piping if this precaution be taken in the insertion of the T-coupling.

Yours truly,

W. B. Buchanan,
Asst. Laboratory Engineer.

Modern Hydraulic Turbines of Large Capacity

With Special Reference to Refinements in Design, Increased Efficiency, Improved Test Methods and Advances in the General Art which makes the Use of Large Turbines Possible

By H. G. ACRES

Chief Hydraulic Engineer, H.E.P.C. of Ontario

ON New Year's Day of 1905, in the plant of the Canadian Niagara Power Company, it fell to the writer's lot to bring up to speed for the official inspection of the Provincial Park Commissioners at Niagara Falls, Ontario, two 10,000 h.p. turbines, the largest units ever built up to that time. Almost exactly seventeen years later, it was again the writer's privilege to turn over the first of the five 55,000 h.p. turbines now installed in the Queenston plant of the Hydro-Electric Power Commission at Niagara, the largest capacity units at present in operation. It was this more or less fortuitous combination of circumstances which suggested a subject for discussion.

Read before the American Society of Mechanical Engineers at Montreal, May 29, 1923.

Not in any sense as a precise definition, but for the purpose of placing a reasonable limit on the scope of discussion, a hydraulic turbine of large capacity may be defined as one having a capacity of not less than 25,000 h.p. and a revolving weight, with the generator rotor of not less than 200 tons, exclusive of hydraulic thrust.

The above limitation on capacity and revolving weight will serve the double purpose of eliminating from the discussion any consideration of low head installations, and at the same time giving prominence to certain problems which become increasingly serious as the operating head ranges upwards from 70 to 80 feet. As units of the class above defined are rarely installed under heads as low as this specified minimum, the discussion is therefore more or less

limited to medium and high head plants.

Where a high operating head is involved, there is always present the problem of controlling high static pressure in the interest of safety; in most cases there is also the problem of controlling and utilizing the flow characteristics of long pipe lines to insure, not only safe, but practicable operation; finally where a copious water supply is associated with a high head, there enters the problem of safely and efficiently controlling a heavily energized water-column, and handling the immense revolving weight of the modern super-turbine.

Briefly, it may be stated that since the 10,000 h.p. prototype of the modern super-turbine went into operation at Niagara 18 years ago, the subsequent outstanding advances in the hydraulic art have been primarily in the direction of safer operation, not only from the personal standpoint of the operator, but from the impersonal, and hardly less important standpoint of the investor and the customer. Another point worth noting is that these advances had to do almost wholly with contemporaneous conditions, when they first materialized, and their possibilities as related to the present status of the art were more or less a matter of subsequent realization. In other words, these advances did not definitely anticipate the super-turbine, but their successful application to contemporaneous practice made its subsequent development technically and mechanically possible.

Static Pressure Control:

Control of static pressure involved in super-turbine water supply is a vital factor in relation to a maximum degree of safety and convenience in operation, and in continuity of plant output. Obviously the mechanism to exercise this function is a valve, and such a valve, for super-turbine service, must have the following general specifications.

(a)—It must be built in any size necessary to accommodate any conduit, however large.

(b)—It must be designed to operate under any static head, however high.

(c)—Its operation must at all times be safe, sure and positive; in opening under full static pressure, and in closing under the most serious plant emergencies, such as the breakage of a wheel-case, or a runaway resulting from failure of governor control.

(d)—It must open and close rapidly, and should have an automatic closing feature to meet the above-mentioned emergency conditions.

Obviously such a specification could not be met by any valve of the ordinary type, nor was it met until the advent of the Johnson automatic plunger valve. It is not within the scope of this article to enter into a detailed description of this valve and its operating principle, suffice to say that it is now an indispensible adjunct to super-turbine installation, and constitutes one of the advances in the general art which contributed to the possibility of present day super-turbine development. As it now stands, the Johnson valve is an adequate

mechanism embodying the ideal elements of simplicity, efficiency and serviceability.

Flow Control:

In the majority of cases the development of a high head involves the use of some type of closed pressure conduit of considerable length. In the case of an automatically governed plant where the ratio of head to length of conduit is more than about 1-10, certain phenomena become manifest which constitute a serious menace to safe and practicable operation. The continuous rejection and pulling on of load increments causes recurrent surges throughout the length of the conduit, which, if not damped out or relieved, will sometimes multiply and become super-imposed to such an extent as to cause pressures enormously in excess of the static head. This condition, in conjunction with the conversion of pressure into velocity head for acceleration purposes, when a large increment of load is pulled on, will impose a duty on the governors which they are not intended to perform, and where long closed conduits are used with turbines gated beyond the point of maximum efficiency, as they nearly always are, a condition may obtain which is entirely beyond the regulating function of the governor.

The power-discharge curve for the ordinary turbine will show a maximum production per second-foot at the point of best efficiency, and the first derivative of this curve will show a rapidly decreasing rate of producion per second-foot from that point to full gate. Consequently, every horse-power pulled on in excess of best efficiency capacity will require a rapidly increasing amount of water to produce it. If, therefore, the turbine is operating at or beyond the point of maximum efficiency, when the system demands a large increment of load, there will be a falling off in production per unit of water supplied, and coincident therewith a loss of effective head, due to the absorption of such velocity head as is necessary to accelerate the water-column. During the period when the water-column is accelerating, it is therefore evident that a condition may obtain where the power output is actually falling off while the water input is increasing, the result being that the governor may open the gates full-stroke in response to the falling speed, at which point its controlling function will cease, until either the system "wr" holds the unit, with dropping frequency, for the space necessary for the governor to gradually resume control on rising speed, or until the generator drops its load and the turbine jumps to runaway speed at full gate, with possible disastrous consequences.

Insofar as the control of surge pressures is concerned, it is evident that if no practical limitations are placed upon it, in the matter of diameter and height, the ordinary standpipe would be an ideal corrective agency. It is clear, however, that in the case of a super-turbine installation, unrestricted scope in design is wholly impracticable from the standpoint of both cost and space limitation. On the other hand, a simple standpipe, feasibly designed and located, may at times actually make

more acute the conditions it is designed to correct or alleviate. This is due to the fact that the simple standpipe can only passively absorb surge pressure, with its recurrent phases, and for this reason often acts as an agency for super-imposing, one upon the other, pressure waves generated by successive changes in load.

Another obvious expedient under this head is to limit the range of velocity change in the conduit by means of a synchronous by-pass, actuated by the governor mechanism. This contrivance can be adjusted to prevent the occurrence of disruptive pressures in the conduit, and also to supplement the influence of the system "wr^2" in holding the unit within the regulating range of the governor when the unit is pulling on or rejecting load. In this connection it is to be noted that the condition under discussion has not necessarily to do with the maximum conduit velocity at any one time, but with the *range of change* in conduit velocity over a short period of time, and with the absorption and building up of head energy induced by these changes, within their low and high limits.

The synchronous by-pass therefore has a useful function, but in the case of a high head super-turbine installation, its usefulness would be largely discounted by its cumbersome dimensions, its waste of water, and an added mechanical complexity which should be avoided whenever possible as a matter of principle.

The discussion under this head has now reached a stage where it is possible to define the specifications of an ideal surge control agency.

(a)—It should have the effectiveness of a simple standpipe of very large dimensions, without its cost and space requirements.

(b)—It should be capable on the one hand of preventing, or counteracting the effect of, any undue absorption of head energy when load is pulled on, and on the other hand of preventing or counteracting the effect of, any serious recurrent surge pressures arising from load rejections, whether isolated or successive.

(c)—The water surface should be sufficiently active to prevent freezing in ordinary low temperatures, and the dimensions should be such as to allow feasible and effective frost protection against extraordinarily low temperatures.

(d)—It should operate without wasting water.

(e)—It should be mechanically simple, with a minimum of moving parts and adjustments.

(f)—It should be entirely dissociated from the governor mechanism, leaving the governor free to perform its own peculiar and highly important function, which is to control the speed of the generator, and not the vagaries of the water-column.

This specification has been met with a large degree of effectiveness by the most wholly original, and at the same time one of the most useful contrivances ever developed in the field of hydraulic engineering; namely, the Johnson differential surge tank. For

those who are interested, ample published data are available concerning the structural details and operating principle of the Johnson surge tank, and for the purpose of this discussion it is only necessary to state that this contrivance constitutes another of the essential advances in the hydraulic art which have made possible the development and safe operation of the super-turbine.

Revolving Weights:

The handling of the revolving weight of a modern super-turbine is governed largely by consideration of efficiency, a matter which will be discussed later, only the mechanical aspect of the problem being considered at this time.

The development of the art under this head exemplifies a condition often met with in the field of engineering, where an inherently sound principle, after being applied in a primitive way, suffers a period of eclipse through arrested development, and perhaps years afterwards is re-discovered, and becomes the basis of the ultimate solution.

In the early days of hydraulic turbine development the step-bearing, a form of combined thrust and guide bearing located under the runner, was used almost exclusively for the support of the revolving element. The subsequent gradual increase in the efficiency, speed and capacity of turbine runners then began to introduce problems of pressure intensity, depreciation and accessibility, which the designers of that day solved, not by improving the step-bearing principle, but by abandoning it, and inaugurating, as a result, the era of the horizontal shaft-turbine. This led to advanced development in bearings of the pillow-block type, together with the introduction of marine type thrust bearings to take up unbalanced runner thrust, a double requirement which gave rise to serious problems when the development of electrical generation and transmission called for continuously increasing turbine capacity and speed. The 20,000 h.p. horizontal turbines in the plant of the Ontario Power Company at Niagara Falls fairly represent the climax of this trend of development, with water-cooled pillow-block bearings of the enormous dimensions necessary to keep bearing pressure within safe limits, and rotor shafts having a diameter far in excess of torsional requirements, simply to minimize deflection.

The original turbines installed in 1896 by the Niagara Falls Power Company represent the first reversion to the primitive basic principle. They were the super-turbines of that period, and were of the vertical shaft type. The revolving weight of these units was partially suspended from, and partially super-imposed on a step-bearing located above the runner and immediately below the generator, thus removing one of the main disadvantages of this type of bearing, that of inaccessibility. A further important innovation was the application of external pressure to a film of oil which was forced in between the moving and stationary elements of the bearing. This oil was usually supplied by gear driven triplex plunger pumps at pres-

sures varying from 80 to 350 lbs. per square inch, and maintained an oil film from two to four-thousandths of an inch thick between the bearing discs.

The oil pressure thrust bearing had a vogue of many years' duration, and some bearings of this type are still in operation. Their disabilities are: expensive investment and maintenance cost, mechanical complexity, and high temperature, resulting in low oil viscosity and high energy losses. Also, even a momentary failure of the pressure oil supply usually results in the loss of the bearing.

Finally, there came the ultimate conception, based on the simple and true embodiment of a basic principle, first established by the experiments of Tower in 1883, and afterwards mathematically demonstrated by Reynolds. It remained for Kingsbury to exemplify this principle in a mechanism which is one of the most outstanding examples extant of the simple and efficient application of a natural law.

The Kingsbury type thrust bearing has the following characteristics which distinguish it from its oil-pressure prototype, and make it an eminently suitable mechanism for supporting, in motion, the revolving weight of the modern super-turbine.

It can be adapted to safely support the revolving weight of the heaviest turbine, within feasible dimensional limits.

The source of oil supply is static, and integral with the bearing itself.

The oil supply is "unlimited" in the sense necessary to conform with the laws of motion of viscous fluids, as ennunciated by Reynolds.

The formation of the "pressure wedge" is not induced by any external agency, but by the motion of the bearing itself, and by providing for a very slight lack of parallelism between the stationary and moving elements.

The wedge pressure is a direct function of the speed of the moving element, and the thickness of the oil film is a direct function of the degree of viscosity of the fluid, and consequently of fluid temperature, which can be regulated within any desired limits by the simple expedient of water-cooling coils.

In a recent action involving the Johnson valve, the trial judge stated in the text of his decision that this valve was a "combination of elements beautiful in simplicity and highly efficient in operation". His observation applies with equal force to the Johnson surge tank and the Kingsbury thrust bearing, besides constituting a very concise general definition of the perfect mechanism.

Apart altogether from their very material contribution to operating efficiency, the mechanisms above discussed introduce a factor of safety and dependability, either singly or in combination, without which the present day status of super-turbine development would have been unattainable.

Refinements in Design:

In classing the turbine governor

under this head the question would naturally arise as to whether or not the governor should not be classed as an essential advance in the art, which, of course, it is. The point is that the items above classified as essential advances were radical departures from contemporary practice, and actually opened up the possibilities of super-turbine development, whereas the turbine governor was enlarged and improved more or less synchronously with the enlargement and improvement of the hydraulic turbine, and to meet the constantly increasing importance of the duty it was called upon to perform.

As the primary requirement of governor operation is precision and reliability, the natural trend of design has been in the direction of simplicity in principle, the reduction of lost motion by the use of a minimum of moving parts, and precise shop work. An interesting development along this line is the White shaft governor, where the centrifugal element is attached direct to the main turbine shaft, thus obviating the complication of a belt or gear drive for the fly-balls.

The double compensation principle, with the restoring mechanism and load limiting attachment, appears to meet all requirements of super-turbine governor control adequately and safely, and speed regulation is assured within safe operating limits for all gate movements up to the full stroke of the servomotors.

Remote switchboard control has also been developed to such a stage that there is considerable latitude as to the location of the actuator, which in some cases is now placed directly over the servomotor cylinders, in others on the machine room floor, and sometimes on the switchboard gallery.

A useful adaptation of the Johnson valve principle has been devised by Taylor for interchanging governor and hand control. Two sets of plunger valves are used, one set on the governor and one on the hand control, and the throwing over of one hand lever will simultaneously close all the governor valves, and open all the hand control valves, or vice-versa.

This operation can be carried out in such a short interval of time that there is little or no chance of losing control of the turbine, and no chance whatsoever of interfering with the proper sequence of operation.

One of the latest innovations in governor design is a motor driven centrifugal element, the motor being located on the fly-ball spindle, and synchronously actuated by the main generator. This device serves the same purpose as the shaft governor in that it eliminates the belt or gear drive.

The activity which has manifested itself during the last four or five years in draft-tube investigation is directly traceable to the vogue of the super-turbine. There are two main reasons for this; first, because the large concentration of power in a super-turbine permits an appreciable increment of useful power to be reclaimed as the result of a gain of only a fraction of a percent in overall efficiency; and second, because the vibra-

tion resulting from vortex action and unsteady vacuum becomes magnified in the super-turbine to such an extent as to often cause serious inconvenience in operation. The pioneer development under this head was the White hydraucone, which marked a distinct advance in this branch of the art.

Briefly, the two-fold object of recent draft-tube experimental research has been to regain as much as possible of the whirl component of the velocity head in the runner discharge, and to devise means of so training the combined axial and whirling flow, through appropriately designed water-passages, as to minimize conditions giving rise to vibratory effects. All experiments carried on along this line by the principal turbine builders have definitely proved the inadequacy of all forms of the elbow type tube, and have developed a series of types, more or less co-related, which have given satisfactory results when tested under operating conditions. Of these types the Moody spreading tube seems to conform most nearly to one's conception of the conditions to be met. This is particularly the case in respect of a cone in the centre of the Moody tube which extends from the invert to the lower extremity of the runner hub. Inasmuch as this cone solidly fills the region of maximum turbulence, it seems entirely reasonable to assume, even without experimental confirmation, that it will be effective in preventing cavitation, and the formation of vortices, with their resultant vibratory effects. Serving this purpose, it also naturally follows that it must affect a useful conversion of the hitherto wasted whirl energy of the central zone, realizing thereby a gain in efficiency as well as a betterment in operating conditions.

In a small high head plant with which the writer had something to do, the turbine showed 85 per cent efficiency on acceptance test. A year later the efficiency had dropped to 67 per cent by reason of excessive leakage through the runner clearance spaces. The head in this case was 550 feet and the circumference of the clearance spaces was about 14 feet. In the case of the 55,000 h.p. turbines at Queenston, the head is about 250 feet less, but the circumference of the runner clearances is about 65 feet. It is evident therefore, that in the case of a runner of this size, under such a head, the leakage factor is a serious matter. As a matter of fact, two of the most recent refinements in turbine design have been devised for the express purpose of meeting this condition; namely, the so-called "labyrinth seal" for preventing leakage through the runner clearance space, and the Overn disc for preventing leakage through the gate clearances.

Instead of the ordinary simple seal consisting of a straight annular passage past the crown of the runner into the space under the head cover, and a similar passage past the runner-band into the draft-tube, the labyrinth seal consists of a series of alternately expanded and contracted passages which destroy the velocity head, and reduce the head on the final free jet to one-third of its initial value.

The Overn disc functions by introducing into the clearance space between the end of the gate veins and the distributor plates, an obstruction to the leakage flow, considerably greater than the diameter of the gate shanks, thus effectively reducing the leakage at these points.

Where the head is sufficiently high to require the use of a cast steel scroll case, a serious problem is introduced, having to do with the cantilever strain on the radial joints between the speed-ring and the scroll case. With the ordinary design, efficient bolt distribution is not practicable, and in the shop pressure test, where the scroll is not supported by a surrounding mass of concrete, the bolts are sometimes stressed beyond the elastic limit, with resultant serious leakage. This disability can be largely overcome by casting the speed-ring stay-vanes integral with the scroll sections, but the pouring and annealing of such a casting is most difficult and uncertain of result. The Taylor sectional scroll case is just as effective and largely removes any uncertainty as to the quality of the casting. Taylor's method is to cast the speed-ring stay vanes integral with a small radial section only of the scroll, and connect later by means of a joint to the main section of the scroll. This joint is so located as to permit of a heavy flange and efficient bolt-spacing, and the castings are of such shape and dimensions that there is every assurance as to their quality after leaving the annealing furnace.

The showing made by the sectional scroll case under shop pressure test indicated that no undue risk would be involved in setting the scroll in the open, with only so much concrete as might be necessary to secure a stable anchorage.

With regard to the pitting and erosion of runners, it may be said that super-turbine development has now reached a stage where this condition is no longer primarily a problem of design, but of economics. In other words if the customer so specifies, the manufacturer can select a specific speed and supply, at a price, a turbine in which the runner will have as long a period of useful life as the other major elements of the installation.

Such a specification on the part of the customer would, of course, involve additional capital expenditure for the generator as well as for the turbine, but, as against this aspect of the situation it must be realized that the modern super-turbine frequently has a capacity which enables it to earn upwards of $2,500.00 every twenty-four hours. Consequently, the lost revenue charge against runner replacement, in a fully loaded unit, may easily run as high as $25,000.00. If this were necessary every two years, it would be equivalent, on a 6 per cent basis, to a capital charge of $200,000.00. Such being the case, it is evident that the choice of a proper economic specific speed is a matter deserving the most careful and mature consideration, being a factor of at least equal importance with proper gateage, and elevation relative to tailwater.

To be concluded in September Number

Some Hazards in Grounding High Tension Neutrals

By W. B. BUCHANAN

Assistant Laboratory Engineer, H.E.P.C. of Ontario

SOME recent experiences in the operation of distribution systems in various Municipalities and the solutions involved indicate that a discussion of various technical features involved would doubtless be of general interest and value. The following explanation is an undertaking to show as clearly as possible how and why such things may happen as have occurred.

CASE 1.

A three-phase four wire distribution system feeds a bank of three single phase transformers having delta connected secondaries. Assume that for the purpose of stabilizing the voltage on other single phase loads, which may be supplied in the vicinity, it seems advisable to ground the high tension neutral of this bank. Serious trouble may result to one of the transformers of the bank in the event of one of the supply lines becoming accidentally grounded especially if the resistance of the circuit through ground be very low.

Referring to Fig. 1, with circuits as shown a ground at x would tend to short circuit the primary of line A to the neutral N through the ground, reducing the primary voltage to zero. At the same time, the voltage on transformer C tends to phase position CA that of B to BA and as a result the secondary of A to three times its normal value. The potential and mechanical stresses which may be set up in this transformer A then may approach closely to those which would occur with three times normal voltage applied to the secondary with the primary short-circuited. Of course, the equivalent impedance of the system would be greater than the impedance of the transformer alone but not by as great a proportional amount as the applied voltage.

Disabled transformers have been examined and all the evidence obtainable appeared to be in harmony with the above explanation and no other satisfactory explanation has so far been advanced.

This hazard is obviated by two transformers V-connected or by isolating the neutral when three are used.

CASE 2.

Cases have arisen also where a customer continued to operate knowing there was an accidental ground on his system. This condition applies as well to 2200 volt. distribution with motor loads at the same voltage. The possibility is introduced of the abnormal voltage stress, mechanical vibration, etc., causing a breakdown at a point in another phase of the same

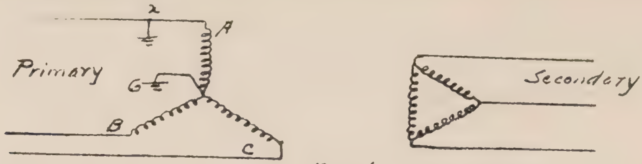


Fig 1.

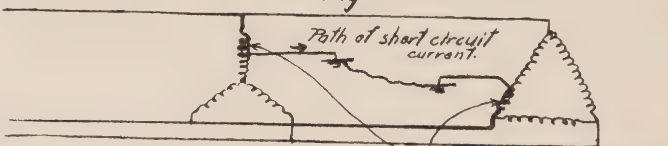


Fig. 2.

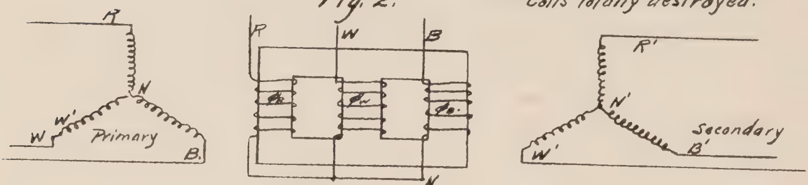


Fig 3.

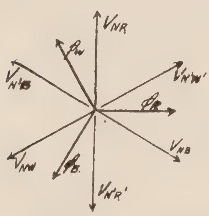


Fig 4.

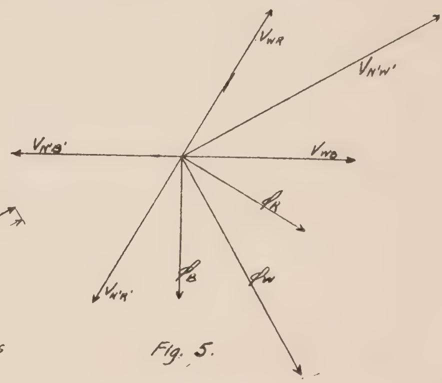


Fig. 5.

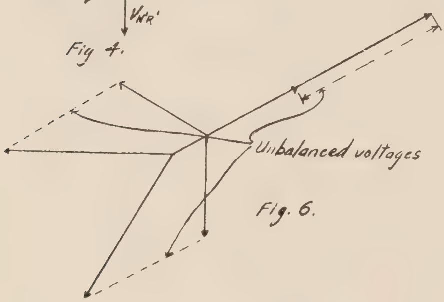


Fig. 6.

machine, or bank, or of another machine or bank. The line voltage would then be applied across two part-sections of windings, (See Fig. 2) which may have less impedance than is offered to line voltage under any condition of normal operation. The destructive effects resulting may be very severe and extend to two pieces of equipment as well.

CASE 3.

A three-phase, four wire system with grounded neutral at the load end feeds a three-phase core type transformer.

A ground on one line, as on the white phase, would tend to cause a short circuit on the primary of this phase, the current only being limited

by the impedance of the circuit through transformer, line and ground. This would apply to individual transformers or to a group in parallel. Of course, if the line were to break or the line end of the transformer otherwise be cleared, this impedance would become practically infinity.

Then referring to Fig. No. 3, the neutral potential N would tend toward line potential W and the voltage applied to phase R would tend to V_{WR} and on B to V_{WB}.

Normally the magnetic fluxes in the cores would balance in the phase relation shown in Fig. 4 and in every case the flux in the core of W must be nearly equal to the vector sum of the fluxes in R and B. Assuming line terminal T disconnected from W so that the voltages are free to take up their respective relations as dictated by the new order of connections, the voltage and flux relations would tend to take the phase relation and values shown in Fig. 5.

From this it appears that voltage V_{WR} applied to phase R is $\sqrt{3}$ times normal and at only 60° displacement from V_{WB} which is also $\sqrt{3}$ times normal. The fluxes in the cores lag in quadrature behind the impressed voltage and the secondary voltages lag in quadrature behind these. The conditions of the core-type transformer demand that the flux in core of W be equal to the sum of the fluxes in R and B and since that in R and B tend to approximately $\sqrt{3}$ times normal and are altered in phase relation, that in W will tend to three times normal but is limited practically by saturation of the core, the exciting current demanded by the secondary winding on the three phases and the impedance the system offers in toto to this new adjustment of conditions. Thus the secondary voltages tend to become $\sqrt{3}$ times normal on phases R and B and three times normal on phase W.

It will now be evident that the electrical and mechanical stresses set up in the W phase may become greater than occurs under any standard test that is ever specified for power transformers. The stresses set up may approach the condition of a dead short-circuit on the high tension with three times normal voltage applied to the low tension side; the voltage between turns to break down the dielectric may approach three times normal; the mechanical stresses between coils of primary and secondary windings of phase W may approach nine times those developed on a dead short circuit test at normal voltage. The sequence of events in the transformer failure would probably be as follows: excessive stresses causing mechanical displacement of coils thus weakening the insulation between turns, resulting in a short between turns, and promptly fusing that winding to open circuit.

CASE 4

It may be seen from examination of Fig. 5 (Case 3) above that should the open circuit develop on the primary of this transformer an abnormal secondary voltage would be developed in that phase and the time-phase relation of phases would be altered considerably. The effect of supplying such a voltage to three-phase induction or synchronous motors might be anticipated from the following an-

alysis of the conditions involved.

We know that a squirrel cage induction motor tends to generate correct three-phase relation between its lead voltages when operating near synchronism, i.e., as a motor below synchronism or as an induction generator above synchronism. If these voltages are not exactly equal to the line voltages applied, the unbalanced components or resultant e.m.f.'s will cause currents to flow through the windings until the impedance drop is sufficient to account for such differences.

Fig. 6 indicates that these unbalanced components may possibly attain values as high as normal line voltages. The external torque (mechanical) would not likely be altered appreciably but the mechanical forces exerted between various sections of the winding might be expected to be much greater than occurs during any normal operation and greater than values that are anticipated in the design of the machines.

So many types of windings and variations in the mechanical proportions exist that it is impossible to do more in this article than suggest the possible cause of some breakdowns we have known to occur. The mechanical forces acting on various current carrying parts may become very much greater than are generally appreciated.

A Remarkable Distribution Transformer Record

By S. B. HOOD

ONE of the larger Middle West utilities has kept a complete record of the performance of their distribution transformers for some years past.

An analysis of this for the year 1922 shows some rather unusual and remarkable results.

The metropolitan area covered by the transformers under observation consists of a total of 3,183 transformers, with an aggregate kilowatt capacity of 50,859; giving an average size transformer of 15.8 kw.

Of these approximately 40 per cent. are used to supply three phase power, the remaining 60 per cent. supplying lighting busses.

The primary distribution is almost wholly "common neutral" with a voltage of 2300/4000. The secondary voltage is 115/230 for light and 230 for power.

A thoroughly grounded neutral network covers the entire area and is used in common for both primary and secondary neutrals; as well as for many other purposes where a ground return conductor is desirable.

During the year there were 212 primary fuses blown on these trans-

formers, or 6.6 per cent. of the total number installed. In other words, under the law of averages, a transformer can be expected to have its fuses blown for any one of numerous causes, once in every fifteen years.

There were actually burned out 40 transformers, with an aggregate kilowatt capacity of 511, or just about one per cent. of the total capacity installed. On this averaged basis the life of these transformers, at present rate of depreciation, will be one hundred years. This is vastly different from that assumed by many engineers, who give fifteen to twenty years as the life expectancy of a transformer.

Of these burn-outs twelve transformers were supplying power and burned out owing to the power bank neutral being grounded and their inability to carry the resulting load in trying to balance up the system or maintain service when one primary phase was shorted or open at the substation. General practice does not recommend such grounding of bank neutrals on this account. The experience of this company, however, has demonstrated its advantages even when weighed against the burn-outs that may result in a few exceptional cases.

Of the 28 transformers serving lighting busses, and burned out, most of them failed through overload due to inability of the field testing crew to keep up with the unprecedented growth in load which was being connected to the lines.

Of those burning out from unknown causes but one unit failed on a day during which there was lightning. This 7½ kw. unit is the only failure during the year that can be fairly charged up against lightning.

This is the remarkable part of this operating record, where the total failures from all causes is less than most companies admit are caused by lightning; and where but one transformer out of over three thousand actually failed from lightning.

The results obtained are probably traceable to a number of protective features standardized on by this system.

First—The common neutral system does away with the condensor action that exists in all transformers where the primary and secondary are insulated from each other. Further, the impressed primary voltage is a maximum at one end of the primary winding, grading down to zero at the other end which is grounded.

Second—The common neutral system holds the maximum potential to that of normal primary potential and transformers are therefore never subjected to steep wave front voltage over-shoot as is common with a free neutral or delta system.

Third—Every transformer is protected on the high voltage end of its primary winding by a lightning arrester.

Fourth—Each transformer has in series with the high voltage end of its primary a small choke coil that tends to reflect high frequency and force it through the arrester.

Just which one of these four items is responsible for the good results is not known; probably each one bears a share in the protection that records conclusively show as resulting.

—Electric Light and Power.

HYDRO NEWS ITEMS

Eugenia System

The installation of the tie line between Niagara and Eugenia Systems —Mount Forest to Harriston, is progressing favorably. The construction of the sub-station and installation of the frequency changer set at Mount Forest is also progressing favorably and it is anticipated that the entire work will be completed early in September.

* * *

The contract for the wood stave portion of the second pipe line at Eugenia has been awarded, and the tenders are all in the hands of the Commission, covering the steel section of same. It is expected that the contract for the steel work will be awarded in the course of a few days and the second pipe line placed in operation before the end of the present year.

* * *

Niagara System

The town of Goderich has received a contract from the Goderich Elevator & Transit Company for an additional 250 kilowatts. This will make a load of approximately 400 kilowatts from this company.

* * *

Construction work has been started in St. Thomas rural district, rebuilding old rural lines and extending them. When completed service will be given to 162 consumers, in addition to 319 who are served by the present lines.

* * *

A rural extension is being built approximately eight and one half miles north from Delaware Station into Lobo Township, to supply consumers in Komoka and vicinity, and also in Caradoc.

* * *

A number of short rural extensions are being constructed in the London rural district, which will total approximately twenty-nine and one half miles. These extensions will add 153 new rural consumers to the district.

* * *

The Village of Beachville is reconstructing its distribution system, changing it from 2300 to 4000 volt connection. The Beachville transformer station is also being doubled in capacity.

* * *

Construction work has been completed for a rural line from Sarnia to Corunna and Stag Island, to serve 95 rural consumers. Plans are under way for extending this line to give service to the Village of Courtright.

* * *

Sixteen miles of rural line are being built west from Wallaceburg to

Port Lambton and Sombra, which will serve over 100 rural consumers.

* * *

A new section of rural line of about five miles in the Chatham rural district was put into service on July 28, adding approximately 40 new consumers to the district.

* * *

Ottawa System

In accordance with a request from the Township of North Gower, rural meetings were held in the villages of North Gower and Manotick. It is proposed to extend the Nepean Rural district and serve this territory with power from Ottawa.

* * *

The recent reported purchase of the Ottawa and Hull Power Co., by A. J. Nesbitt, of Montreal, for $4,000,000, has caused considerable comment in Ottawa.

* * *

Rideau System

The judgment delivered by Mr. Justice Rose, in the recent action of the Kemptville Milling Co. vs. The Village of Kemptville, contains a number of interesting points with reference to a private company's rights on the streets of a municipality. The result of this judgment is that the Kemptville Milling Co. action is dismissed, and there is judgment in favor of the Village of Kemptville upon a counterclaim for $500.00 and costs.

* * *

Messrs. Findlay Bros., of Carleton Place, manufacturers of stoves and furnaces, are preparing to put a new line of electric ranges on the market, and are installing in their factory an electric annealing oven of about 100 h.p. capacity.

* * *

Severn System

Due to the increased demand for power in the municipality of Coldwater, the present transformers in the sub-station are being replaced with larger units, which will give an additional capacity of 50% over and above that of the original transformers.

* * *

The Grand Trunk Pacific Elevator at Midland is being enlarged and this concern will require an additional 200 or 300 h.p. from the Commission by October or November next.

* * *

The rural line serving the Barrie Rural Power District which serves the community in the vicinity of Shanty Bay was made alive on July 17th and service made available for rural customers in that district. Most of the contracts on this line cover service to summer cottages.

* * *

The rural lines serving the Wasaga Beach summer resort were made alive and placed in operation July 9th, and about 130 summer cottages are now being served at this location, service being obtained through the Stayner Sub-station and Distribution System.

* * *

St. Lawrence System

The Police Village of Spencerville in the Prescott Rural District has its new street lighting system in operation.

Wasdell System

The construction of rural lines in Mariposa Township for service to a large farming community as well as to the Police Villages of Little Britain and Oakwood is progressing favorably and it is expected that this system will be made alive about September 1st. A separate sub-station for serving this district is being constructed at Pinedale, located on the Wasdell transmission line between Cannington and Greenbank.

Your Job, Your Pay And Your Company

Why you are hurt when your company is hurt and where your personal interests lie

By GEORGE WELSH WEBER

THE man who works for a public utility company, aspiring to advancement in position and salary, must take into consideration the financial condition of the company that employs him. Such a worker should investigate and particularly take into account two principal factors which must bear directly upon his own personal welfare as an employe of the company:

1. The public utility company must be in a self-supporting condition. Especially, it must not be regulated as to price and character of service by public authorities in such a manner as to make it unable to deal fairly with its deserving employes.

2. The worker in a prosperous public utility company should establish his right to promotion and increased salary by demonstrating his worth and usefulness.

Employe and Public

Other conditions permitting, the right sort of worker will climb upward more rapidly that he who is indolent and unreliable. The work of the corporation has to be done, and well done or the public will complain —and will have a right to do so.

The public service corporation is the servant, not the master, of the people, and the worker in it must accept the truth that he who serves the public most satisfactorily serves his company best. To take care of himself the man at the top must take care of the service, and the men under him have got to do the same. Wise general management sees to it that the fit and unfit workers are dealt with according to their merits.

How Employes Climb

Another fact which the employe should take into account is that even the deserving worker cannot hope to find his proper place in the twinkling of an eye. He may have to be content to be a straphanger on the road to promotion longer than he likes; but, at length he will find a seat. The road to the top is always crowded.

The ambitious employe should not lose sight of the fact that in a large organization the process of screening

the fit from the less worthy is necessarily tedious and requires time. Men must be time-tested as well as stunt-tested. Good men ahead of the ambitious and deserving cannot rightly be discharged just to make room for good men who may be in the ranks below.

If the employe will look about him he will see that, in the long run, the capable and ambitious employe is well taken care of and that the high executive positions in the company as a rule are filled by that kind of men who have grown up with the company.

The first of the foregoing propositions is really the most important for the worker to consider. This is particularly true at this time when the effort of unthinking people is to so drastically regulate public utility rates as to bring positive injury to the corporations performing the service.

This tendency is promoted by two principal classes of agitators: first, there is the group who would change our system of government and economies to the Russian sort—wherein all property is owned by the government and the worker is detailed to duty the same as the conscripted soldier. The second group is made up of agitators who seek to endear themselves to the thoughtless of the voting population by appearing to be deeply concerned about the prices and service of public utility corporations. Some of this latter group manage to obtain enormous payments from taxpayers' money to carry on impossible fights against different kinds of public utility corporations—as lawyers—as experts.

Most of the agitators are persons seeking to obtain election to public office. Often noisy candidates run on a reduce-the-price-of-gas or on a-seat for-everybody, platform for offices in which, if elected, they would be without power to do anything as to such service regulation.

Employe's Duty to Himself

The fact that the worker in a public utility company must depend upon the prosperity of the company which employs him for promotion and better pay—and, perhaps even for continued employment—makes his own interest to be the same as that of the company. If the company be on the down-grade it cannot put him on the up-grade. The worker and his employer are partners in this as well as in other particulars. That much needs no further explanation.

What's the answer to it all?

First, last, and all the time, that the direct personal interest of every public service employe is exactly the same as the corporation which employs him. And, that is to say that his own interests compel him to regard as a personal enemy those who seek to make the source of his living a football of politics to advance either communistic propaganda, or to elect hungry office-seekers to office. To aid and abet, or to fail to oppose, company enemies is treason to the employe's own living resource. To be a bystander when his own home is being destroyed, amounts to helping the destroyer.

Act for Self Protection

The public service employe is not so blind that he will not see, nor so

wise that he will not take care of himself and his own. And, this does not mean that the defender of the company should merely refrain from uniting with the company's enemies in fight on its prosperity. It means that he should take up arms against those who to help themselves disregard the welfare of others.

To effectively take care of himself and the sources from whence he draws his living, the public utility employe should educate himself in relation to the affairs of his company and the things which dangerous regulation may attempt to do to it. He should stand ready to come back at those who would rob his purse before his rightful pay finds its way into it.

That is the answer.

—Public Service Company of Northern Illinois News.

One Hundred Per Cent Loyalty

Two years ago three executives of an important Canadian industrial house, with agencies all over the Dominion, sat in consultation upon the appointment of a branch manager. The President, after much thought, laid one name before the meeting for the position. The Secretary raised his brows in surprise at the recommendation. It was that of an old servant of the company, but until this minute he had always been apparently an unimportant cog in this great industrial machine.

"Is he a business getter?" the Secretary asked. "Can he hold down this position? There are other smarter men whom we can promote."

"I admit that," said the President. "But are they imbued with the same loyalty to our interests? Jones here—" he picked up his recommendation slip—"Jones here, is one hundred per cent loyal.

"I believe in loyalty above everything else, loyalty to your company, your superiors and the men with whom you work.

"Loyalty, one hundred per cent loyalty, will make Jones a business getter. A man loyal to his company is loyal to himself. That very loyalty will make him rise to the responsibilities of his new position. I know men; therefore, I know Jones. In fact, I have been watching him for some time, although he does not know it. I would ask you to concur in this appointment."

All this happened two years ago. Jones got his big chance that afternoon in the President's office, although at the time he did not know that his name was known in the organization beyond the narrow confines of his own small department. Since that day Jones has got another appointment. The President was a shrewd judge of character. Jones was one hundred per cent loyal. To be that he had to be loyal to himself. Not only did Jones prove a business getter but he planted his feet firmly upon the ladder of success which in that industrial house leads to a private office and an executive chair.

Yet two years ago Jones believed himself to be an unknown man even to his own organization.

There are many men to-day who

have slumped because they believed themselves unknown and faltered by the way just as the executive eye had marked them out for promotion.

A man one hundred per cent loyal never falls down on his job. He is loyal to himself, to his fellow workers and to his company.

It is true we can't all be executives and sit in private offices. There must of necessity be helpers. But a worker who is one hundred per cent loyal gets a satisfaction and a joy in working which is denied the disgruntled one and the slumper.

For all you know maybe you are a Jones slated for promotion.

The greater the company the greater the opportunities for advancement. No man one hundred per cent loyal can be overlooked. He may be stationed in an out-of-way place at present. But he will not stay there.

Loyalty is the greatest asset a company can have. One hundred per cent loyalty makes a man a priceless asset to his employers. Sooner or later the official hand will reach out, pluck him from his particular niche and place him on the road to greater things. It does not pay to be a slumper. The slumper never gets anywhere.

Take stock of yourself. Are you one hundred per cent loyal?

—Canadian National Railways Magazine.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in July 1923.

Appliances

D. MOORE COMPANY, Hamilton, Ont.

Stationary Electric Air Heaters Cat. Nos. 40 and 50.

* * *

THE CAPITAL HEATING AND MANUFACTURING COMPANY, LIMITED, 41 Garneau St., Hull, Quebec.

Portable and Stationary Hot Plates, Cat. Nos. 6,12,20D; 30,30A.

* * *

THE HOOVER SUCTION SWEEPER CO. OF CANADA, LIMITED, Hamilton, Ont.

Vacuum Sweeper Model 961.

* * *

THE WILLIAM CAMPBELL SALES COMPANY, Georgetown, Ont.

One, two, and three element Portable Electric Ovens.

* * *

UNION MACHINERY COMPANY, Joliet, Ill.

Portable Hand-operated Bread-Wrapping and Sealing Machine.

* * *

TRIPLEX MOTION PICTURE MACHINE CO., LIMITED, 4 Hospital St.,

Montreal.
Combination Air Heater and Hot Plate, Type D.

* * *

The Nell and Tom Electric Toaster Co., Grimsby, Ont.
Portable Electric Hot Plate.

* * *

Superior Electrics, Limited, Pembroke, Ontario.
Circulation Water Heaters, Cat. Nos. 31 to 36 incl., and Portable Reflector Type Air Heater, Cat. No. 65.

* * *

Keith Electric Refrigerator Co., Limited, 297 Campbell Ave., Toronto.
"Keith" Electric Refrigerators.

* * *

* The Automatic Electrical Devices Co., 120-2 West Third Street, Cincinnati, Ohio.
"Homcharger" vibrating rectifier for charging automobile and radio storage batteries "Radio De Luxe" Model.

* * *

Fittings

St. Thomas Metal Signs, Limited, Talbot St., St. Thomas, Ont.
12 Ply Cardboard Lamp Shades, for advertising purposes.

* * *

Mr. W. P. Marr, 102 Russett Ave., Toronto.
"Marr" solderless connectors for fixture work.

* * *

The Federal Porcelain Co., Carey, Ohio.
"FEDCO" Porcelain Knobs, Cleats, Tubes and Bushings.

* * *

The R. Thomas & Sons Co., East Liverpool, Ohio.
Porcelain Knobs, Cleats, Tubes and Bushings.

* * *

* The Bryant Electric Co., Bridgeport, Conn.
Fuseless Attachment Plugs, Cat. No. 651.

* * *

* The American Tube and Pipe Bending Co., 880 E. 72nd. St., Cleveland, Ohio.
"American" formed elbows for rigid conduit.

* * *

* Holfast Rubber Co., Atlanta, Ga.
Combination Friction and Rubber Tape "2-Plex."

* * *

* Benjamin Electric Mfg. Co., of Canada, Limited, 11-17 Charlotte St., Toronto.
Attachment Plug with Switch for Heating Appliances. Cat. No. 7051.

* * *

* Connecticut Electric Mfg. Co., Bridgeport, Conn.
Medium Base Sockets, Cat. Nos. 14010, 14050-52 incl., 11029, 11032, 11033, 13029, 13032, 13033, 9366, 21026, 21029, 21032-33, 11160, 11161.

Medium Base Receptacles, Cat. Nos. 12016, 12019, 12026 S.B., 50717, 50718, 14054, 14054 S.B., 14058, 14060, 1603, 1608-11 incl., 1640-44, 1646-47, 2749, 9002, 9009, 9400-01, 9403, 1633-36 incl., 11038, 11041, 11047, 11049, 50716, 50739-40, 1602, 1604-07 incl., 9009, 50716.

Receptacles for Attachment Plugs and Plugs. Cat. Nos. 3010, 1075, 1095, 8002, Adapter 1081.

Fuseless Rosettes, Cat. Nos. 13083, 13094, 13086, 13096.

* * *

Switches

Canadian Westinghouse Co., Limited, Hamilton, Ont.

Auto-transformer Starters, Type K2, Style Numbers H 15200, to H 15229 incl. Type K1, Style Numbers H 17924 to H 17945 incl.

* * *

* Monitor Controller Co., Frederick and Lombard Sts., Baltimore, Md.

Automatic Starting Rheostats, 1/4 to 300 h.p., 500 Volts or less.

* * *

* Cutter-Hammer Mfg. Co., Milwaukee, Wis.

Battery-charging Rheostats, Bulletin No. 11407.

Self-Starters, Bulletin No. 6170-1.

* * *

* Canadian General Electric Co., Limited, King & Simcoe Sts., Toronto.

Oil-Break Switches, Type FP-15, Type FP-3, Type FP-6, and FK-20.

* * *

* Reynolds Electric Company, 422-28 S. Talman Ave., Chicago, Ill.

Electric Sign Flashers "Reco".

* * *

* The Connecticut Electric Mfg., Co., Bridgeport, Conn.

Surface Switches. Cat. Nos. 2300, 2301, 2310, 2311, 2303, 2316. Push Flush. Cat. Nos. 6076, 6276, 6077, 6277, 6078, 6278.

* * *

Fixtures

* McGill Mfg. Co., Valparaiso, Ind.

Vaporproof Fixtures, Cat. No. 3001.

* * *

Miscellaneous

Ontario Gypsum Co., Limited, Paris, Ont.

"Gyproc" Plaster Board for use in lining wooden cabinets and meter-boards.

* * *

* Eugene F. Phillips Electrical Works, De Gaspe and Marmier Sts., Montreal, Que.

Slow Burning Wires.

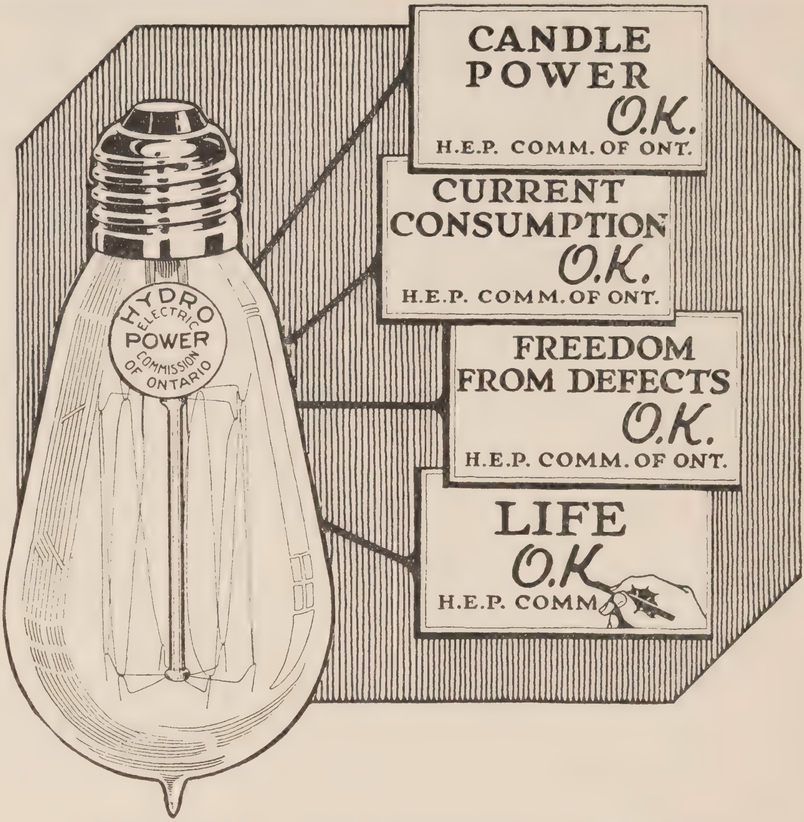
* * *

* Northern Electric Co., Limited, Montreal, Que.

Wires,—Weatherproof, Slow-Burning Weatherproof, and Slow-Burning.

* * *

* These devices are under the Underwriters' Laboratories re-examination or label service.



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Second — For Current Consumption
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The Hydro-Electric Power Commission of Ontario

THE

BULLETIN

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HYDRO-ELECTRIC POWER COMMISSION
of Ontario

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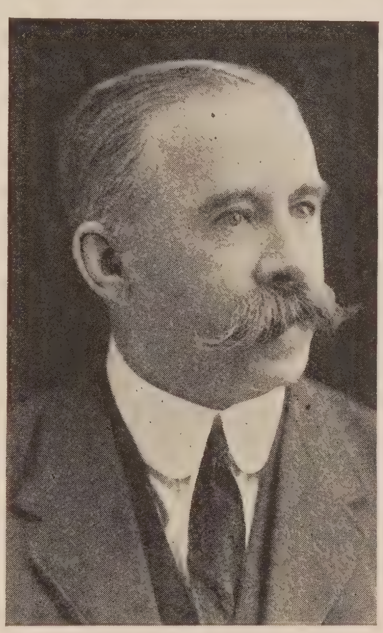
Welcoming Commissioner Cooke

THOUGH a Canadian by birth, Hon. John Robert Cooke is a pure blooded Irishman. He was born at Harold, Ontario (Hastings County) on September 1, 1864, where his parents had decided to make their new home. It was here that he grew up and received his preliminary education, the foundation on which he was able by continued study to carry on as he became more and more a man of prominence.



Hon. J. R. Cooke

His public life began in 1900 when he was elected as Councillor in Rawdon Township. This position was held by him till 1908 when he became Deputy Reeve. In 1910 he advanced another step when he became Reeve. The next year he was elected member to the Ontario Legislature for North Hastings by acclamation which seat he has continued to hold. Mr. Cooke has shown an active interest in public affairs. He is a man of few words and a deep thinker. On account of his keen interest, and untiring energy in public affairs he was appointed Minister without Portfolio in the new Government formed on July 16, 1923, and also Cabinet Member of the Hydro-Electric Power Commission of Ontario.

In welcoming Mr. Cooke to the Hydro-Electric Power Commission we

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SEPTEMBER, 1923

wish to extend to him our hearty good wishes. We feel assured the Commission has gained much by his appointment and that with his co-operation with his associates and personal influence elsewhere the principle of municipal ownership of public utilities will become even more firmly anchored in the Province of Ontario.

Electric Baking

The report extracted from the Electrician on tests made by Mr. John W. Gregg comparing baking by electricity and gas, is prepared to show that by use of electrically heated ovens the results obtained in quantity and quality of the product are sufficient to warrant their adoption. The tests on which the report is based were conducted in New York where the cost of electricity is considerably in excess of that in Ontario Municipalities. It was found that the electric oven created a power bill of approximately $100 per month while the cost of gas for the gas fired oven was approximately $45. The difference in fuel cost is practically paid for by the saving in shrinkage.

The electric bake oven used had a capacity of 25 kw. and took on an average 3200 kw-hr. per month. The gas oven used 39,000 ct. ft. of gas per month. Had the tests been conducted in Toronto the bill for electricity would have amounted to $57.68 and for gas $34.15. This shows electric heat to cost $13.53 in excess of gas. With the saving in shrinkage of $54.69 as shown in Mr. Gregg's report the monthly balance in favor of electric baking is $41.16 apart from the other advantages outlined by him. By applying the rates in use in the other Municipalities after the same manner as the Toronto rates have been applied it will be found that in the majority of cases electricity is more advantageous, while in some the cost of electricity will be very close to if not lower, than the cost of gas.

The Fifteenth Annual Report

THE Fifteenth Annual Report of the Hydro-Electric Power Commission has now been released and is being forwarded to the municipal officials. It is in every way the most interesting report that has so far been issued and records an operation successful, in general, beyond the expectation and hope of the most loyal and enthusiastic supporters of Hydro.

Every reader of the Bulletin should make it his business to secure a copy of this report without delay, and study the municipal balance sheets, operating reports and operating data which will all be found in the familiar form in which they have been presented for the past ten years.

There are detailed balance sheets for 226 municipalities, and operating reports for 214, an increase for the year of 11 and 9 respectively. The consolidated balance sheet for all municipalities shows the percentage of net debt to total assets as 65.6% as against 88% in 1913. This does not include as an asset the equity in the Sinking Fund of the Provincial Systems which is being automatically acquired in the cost of power.

The operating report is most gratifying. On the Niagara System there was a material advance in the cost of power at the power houses, which seriously affected the municipalities located relatively near Niagara Falls where the cost of transmission is a relatively small part of the total cost. Those municipalities located furthest from Niagara fared more fortunately, as in most cases the decrease in the cost per horse power for transmission due to natural increase in the load more than offset the increased cost at point of generation.

Of the 137 operating municipalities in the system there were but 13 reporting a total gross loss of $18,364.60 and 29 including the foregoing failed to provide full depreciation. However the net surplus provided by 248,729 consumers on this system was $406,330.42 after setting aside a depreciation reserve of $600,114.20 which does not leave much room for complaint.

All of the smaller systems show a material improvement. On the Severn System there was but one municipality having a gross deficit, the actual amount being $107.25 and the 17 municipalities with 7520 consumers show a net surplus of $46,996.62 after providing a depreciation reserve of $15,521.48.

The Eugenia System with 23 municipalities and 8218 consumers had a net surplus of $38,911.69 after providing $16,214.50 for depreciation, there being five municipalities in which actual losses occurred amounting in total to $3,628.76 as against gross deficits on this system of $22,511.05 in 1921.

There was but one case of loss in the Wasdell System of $83.58 out of a total of 8 municipalities with 1447

consumers. The net surplus was $11,049.36 after providing for $1,248.00 depreciation.

The Muskoka System with two municipalities and 914 consumers showed a net surplus of $2,627.95 after providing for $2,035.00 depreciation.

Four municipalities of the ten making up the St. Lawrence System with 4041 consumers show a gross loss of $3,004.52 although the total net surplus amounts to $23,739.92 in addition to $6,323.00 depreciation.

The Rideau System with five municipalities and 3703 consumers shows a net surplus of $25,592.07 after providing for $7,300.00 depreciation. Each municipality had a surplus.

Thunder Bay System now embracing only Port Arthur, with 3865 consumers reports a net surplus of $8,059.85 after providing $11,492.00 depreciation.

Ottawa System including only the City of Ottawa with 12.138 consumers shows a net surplus of $48,979.71 after setting aside $36,743.00 for depreciation.

The Trent System embracing ten municipalities with 12,515 consumers taking power from the Central Ontario System shows a net surplus of $83,049.71 in addition to a depreciation reserve of $18,823.00.

The summary shows that all systems, with 303,090 consumers, operated with a net surplus of $695,337.30 after providing for $715,814.24 depreciation.

Ten Years Of Progress

IT is undoubtedly and naturally true that to the casual user of Hydro, the measure of success or failure of the enterprise as a whole is the monthly or bi-monthly bill received for the individual service. If the bills are reasonably small, and below the average cost of similar service in other localities, it is inevitable that the consumer should feel that the system is sound in conception and operation. This, however, is only the superficial aspect and does not mean anything unless considered in connection with the annual operating statements and balance sheets. A service at rates below cost may be temporarily gratifying, but will bring a day of reckoning when the books are closed at the end of the year,—while on the other hand, a balance sheet showing a substantial margin of profit and an accumulating surplus is the true measure of successful operation providing the surplus is not the result of excessive rates.

So far as the rates charged in Hydro municipalities are concerned, there is and can be no question. Year by year the rates have been lowered,

until they are in many cases less than one quarter of those in effect prior to Hydro, and these low rates have enabled the consumers to make use of the utility in ways undreamed of at the old costs, in cooking ranges, washing machines, irons, toasters, small portable heaters and a host of similar appliances that have to a marked degree increased the comfort of home life, with the result that year by year the consumption per consumer and the revenue have increased beyond every anticipation.

Just how successful the enterprise has been as a whole is seen from a study of the consolidated balance sheets of all Hydro municipalities at the end of 1913 and after ten years at the end of 1922.

Consolidated Balance Sheet Of All Hydro Municipalities As At December 31st.

	1913	1922
Number of Municipalities	45	226
ASSETS		
Plant	$10,081,469.16	$42,706,840.87
Cash & Securities	450,887.97	1,608,274.42
Accts. Receivable	344,487.95	3,874,317.14
Inventories	540,274.58	1,738,795.96
Sinking Fund on Local Debentures	431,747.27	3,416,231.45
Equity in Hydro System		1,543,434.12
Other Assets	58,959.93	238,940.13
Total	$11,907,826.86	$55,126,834.09
LIABILITIES		
Debenture Balance, Accounts Payable and Other Liabilities	$10,468,351.79	$35,196,388.35
Depreciation Reserve	478,145.88	6,512,813.92
Equity in H.E.P. Comn.		1,543,434.12
Debentures Retired	202,751.26	3,104,591.15
Local Sinking Fund	431,747.27	3,416,231.45
Additional Operating Surplus	326,830.66	5,353,375,10
Total	$11,907,826.86	$55,126,834.09
Percentage of net debt to total assets	88.0%	65.6%

The number of municipalities included has increased from 45 to 226 but it will be noted that the average plant investment is about $35,000 less due no doubt to the fact that in the beginning the service was available principally in cities and towns while now it has been extended to villages and hamlets where originally, service at a practicable rate was not thought possible, but in these same villages, thanks to the universal follow up maximum rate of two cents authorized by the Commission during the past year, an electric range is now within the limits of the average purse.

The total quick assets such as cash, securities, book accounts, inventories and sinking fund now amount to over ten and one half million dollars or about 30% of the total liabilities including the debenture debt, leaving entirely out of consideration the plant value for which the debentures were originally issued.

While a net operating surplus of $5,353,375.10 is shown, it must be remembered that this is after retiring coupon debentures amounting to $3,104,591.15, after providing a sinking fund to apply against unmatured debentures of $3,416,231.45 and after providing a depreciation reserve of $6,512,813.92. In other words, the almost unbelievable fact is that the Hydro municipalities collectively, in the twelve years of their operation have met all ordinary costs of operation and have piled up what in any commercial system of book-keeping would be considered a surplus of $18,387,011.61 or more than 50% of their total present liabilities.

The balance sheet shows another modest asset of $1,543,434.12 which is not taken into account in the above. This is the sinking fund on the provincial system which has been included in the cost of power, and measures the progress of municipal ownership in the developments and transmission systems. Owing to the legislation which permitted the deferring of this charge for five years, this asset was rather slow in assuming formidable proportions but a comparison of this asset in the last few annual reports will give a fair idea of how fast it is now growing, and perhaps but few consumers realize that in paying their small monthly bills over the local counter, they are not only paying for a month's service, but are actually paying an installment on the first cost of both the local and provincial system, and will be the owners of debt free plants within a comparatively short time.

Still more interesting is a study of the condensed operating report showing the revenue and expense accounts comparatively in 1913 and 1922, which indicate in a graphic way the remarkable increase in revenue. It is of more than passing interest that the percentage of increase in the total cost of energy is less than the percentage of increase in revenue from domestic consumers, and that while the total revenue increased 388%, domestic lighting 571% and power 492% the revenue from street lighting shows a comparatively nominal increase of 107%. This should definitely put an end to the old charge that Hydro equalizes a lighting rate below cost by collecting an excessive charge for

Consolidated Comparative Operating Report For All Hydro Municipalities For The Years 1913 And 1922.

	1913	1922	Percent. Increase
Number of Municipalities	45	214	
Number of Consumers	65,607	303,090	
REVENUE			
Domestic Light	$572,154.38	$3,786,608.23	571.%
Commercial Light	525,438.16	2,158,306.34	310.
Commercial Power	905,378.17	4,383,912.97	492.
Municipal Power	*	923,263.38	492.
Street Lighting	560,925.56	1,160,446.81	107.
Rural Service		** 105,877.09	
Miscellaneous	53,543.24	187,689.39	251.
Total	$2,617,439.51	$12,756,104.21	388.
EXPENSES			
Power Cost	$789,632.87	$6,636,853.37	741.
Operation, Maintainance and Administration	723,001,32	2,996,785.01	314.
Debenture Charges and Interest	528,549,21	1,710,127.34	224.
Total	$2,041,183.40	$11,343,765.72	455.
Gross Surplus	576,256.11	1,412,338.43	145.
Depreciation	262,675.24	715,814.24	172.
Net Surplus	$313,580.87	$696,524.19	122.

* Municipal power included in Commercial power in 1913.

** Does not include revenue in Rural Power districts operated direct by the H.E.P. Comn.

street lighting. The collection from street lighting in all municipalities is now approximately 11% of the total revenue and in 1922 was $251,891.52 less than the gross surplus, so that had this service been rendered free, the municipalities would still have had a gross surplus of over a quarter of a million dollars from the year's operation.

This statement covers the municipal enterprises only, and does not include those municipalities making up the Central Ontario, Nipissing and Essex County systems, which are not municipally owned, nor the rural power districts which now serve more than 4000 consumers, all of which are operated direct by the Hydro-Electric Power Commission.

Debt Free Hydro Systems

IT is a questionable compliment to speak of a municipality as having no debt. The statistics show some such curiosities, but on investigation it is usually found that their freedom from debt is largely due to the same reason that the Indians who possessed this fair land had no debt, because they have but few of the modern conveniences such as good roads, permanent bridges, drainage, modern schools and public buildings and rural telephones which more progressive municipalities consider essential. It all depends on our outlook on life and the earnestness with which we carry on the great commission given to our forefathers to possess and conquer the earth.

With this thought in view it is refreshing to find on page 295 of the 1922 annual report a list of eighteen Hydro municipalities in which the quick assets belonging to the Hydro utility such as cash, securities, book accounts and stores exceed in value the total liabilities including debenture debt. In other words, if these municipalities could call in their unmatured debentures issued on account of Hydro, they have sufficient available assets to pay off the debt, and still have a balance of working capital which in one case amounts to nearly $40,000.00.

These municipalities are listed below, with the *excess* of their quick assets over all liabilities:

Acton	$ 165.31
Baden	1,782.01
Barrie	39,316.93
Beachville	6,195.49
Bothwell	1,422.34
Collingwood	14,959.80
Creemore	3,778.42
Elmvale	142.92
Georgetown	5,555.44
New Toronto	1,840.36
Norwich	1,964.00
Ridgetown	5,902.46
Rockwood	46.30
St. George	1,880.05
Tavistock	6,545.25
Waterdown	2,120.11
Waterford	3,574.24
Zurich	21.13

A more remarkable state of affairs is difficult to imagine and as the report lists thirty-two additional municipalities where the net balance of debt over quick assets is nominal, in one case but $19.89 there is no question but that the year 1923 now rapidly drawing to a close will see a large addition to the eighteen municipalities now making up the "honor roll".

Is Electric Baking Economical?

Some Figures Showing That It Is

By JOHN W. GREGG

ALTHOUGH it is generally conceded that electrically heated baking ovens have many advantages over those heated by other means, the relatively high cost of electricity on a B.t.u. basis has led many to believe that the advantages of electric baking are not sufficient to off-set the differences in the relative cost of the fuels. To show accurately that these advantages do more than off-set the difference in fuel costs a series of tests was conducted recently at the market of Charles Weisbecker, Inc., 125th Street, New York City, with a Westinghouse electric reel type bake oven and a gas oven of the same type. Only three of the advantages of electric ovens are considered in these tests. They are: 1. That the electric oven will bake more goods in a given time than will a gas oven of equal shelf capacity; 2. That the electric oven will save enough material by reducing shrinkage to more than balance the difference in fuel cost; 3. That products baked in the electric oven retain their moisture longer, and therefore remain fresh and saleable for longer periods after coming from the oven.

Heat Basis Not The Sole Contention

Before presenting these tests let us observe that electricity cannot be compared to other fuels on a heat unit basis, because this method of comparison disregards the practical application of the heat generated to actual baking and cooking processes. Heat generated by a fuel is not the basis of comparison. The heat actually utilized in baking forms the basis of comparison of fuels.

A test was first made to determine the comparative capacities of the two ovens. The factors involved in this test were the ease with which the ovens could be operated, the speed at which the ovens would bake, and the ability of the ovens to maintain the proper baking temperatures.

Both ovens were operated to produce the greatest possible quantity of goods. The ovens were in operation from 8 a.m. to 4.30 p.m., with a forty-five minute wait in the afternoon because of a lack of material to be baked. Ten runs were made, and the following variety of products was baked in each of the ovens:

Duchess cakes, wine cakes, princess cakes, nut cakes, spice cakes, loop cakes, pound cakes, fruit bread, Boston brown bread, soda bread, small bread, large bread, cottage bread, Parker house rolls and scones.

A Wide Range Of Temperature Necessary

The baking of these products required a wide range of baking temperatures, and therefore the ease of

altering the temperature of the ovens played an important part in bringing about the following results: In ten runs the electric oven baked 818 lb. of products as against 684 lb. in 18 gas ovens. The difference in favour of the electric oven was therefore 134 lb. of products.

The greater output of the electric oven was due to its ease of operation and labour saving features, its fast baking qualities, and its automatic temperature control, which assured maintenance of the proper baking temperature without the attention of the baker. This feature of greater production will be appreciated by every baker, and especially by the baker who needs to conserve floor space.

Savings From Reduced Shrinkage

Special runs were made on bread and loop cakes to determine the amount of material saved by the electric oven. The results obtained show savings exactly corresponding to those made at other bake shops using Westinghouse electric ovens.

The Weisbecker Market bakes approximately 3000 loop cakes and over 24000 loaves of small bread each month.

Savings Effected

Loop Cakes—3000 by 5/6 oz. per cake=2500 oz.=156-1/4 lb. 156-1/4 lb. by $0.19 per lb.=$29.69 saving per month.

Small Bread—24000 by 1/3 oz. per loaf=8000 oz.=500 lb. 500 lb. by $0.05 per lb.=$25.00 saving per month.

On these two items alone this bakery saves approximately $54.69 each month. In addition, similar savings in material are made on all of the other products baked.

This oven is supplied with power at 3 cents per kw-hr. and its consumption average 3200 kw-hr. per month. Thus the electric power bill is approximately $100 per month. The gas oven in this bakery consumes about 39000 cu. ft. monthly, and the gas rate is $1.15 per thousand cubic feet. The gas bill averages $45 per month. As-

Gas Oven Weight

Product	Before Baking	After Baking
6 loop cakes	24 lb. 0 oz.	22 lb. 4 oz.
12 Small bread	10 lb. 8 oz.	10 lb. 0 oz.

Electric Oven Weight

Product	Before Baking	After Baking	Savings of Electric oven during Baking
6 loop cakes	24 lb. 0 oz.	22 lb. 9 oz.	5 oz.
12 Small bread	10 lb. 8 oz.	10 lb. 4 oz.	4 oz.

These results show savings during the bake, which become very great when applied to a month's production.

suming that the gas oven bakes as much goods as the electric oven (which is not true as shown by test

1), the difference in fuel cost is $100—$45.00=$55. But on two products alone Mr. Weisbecker saves about $54.69 per month in shrinkage, and this practically pays for the difference in actual fuel costs. The savings resulting from reduced shrinkage on all other products is profit.

The Keeping Qualities Of Bread Baked Electrically

The bread baked for test 2 was weighed again 5 hours after it came from the ovens, and the electrically baked bread had shrunk less by one ounce than did the bread baked by gas.

	Gas Oven	Electric Oven
Weight on coming from oven	10 lb. 0 oz.	10 lb. 4 oz.
Weight 5 hours later	9 lb. 10½ oz.	9 lb. 15½ oz.
Loss in 5 hours	5½ oz.	4½ oz.

This shows that the drying out process, which is a large contributor to the staling of bread, goes on much more slowly in the products of the electric oven. Every baker is striving to produce products with long keeping qualities because they are of great concern to the housewife, who always chooses the bread which retains its palatability longest.

Therefore apart from the quality of the products produced, cleanliness, no fire hazard, and labour saving advantages, the electric oven justifies itself economically on the basis of (1) increased output for surface capacity, (2) reduced shrinkage in materials and (3) decreased loss through stale goods.

—The Electrician.

The Girl At The Window

Being a Philosophical Discussion of the Importance and the Influence of the Front Office, the Front Window and the Young Woman who sits Behind it.

By WARREN R. VOORHIS

Vice-President, American Water Works and Electric Co., New York

I HAVE great respect for chief engineers of local plants. They are at ease in the presence of vast, fearsome machines; they can read blueprints and make curves that will prove anything to one who does not understand their curves.

I am abashed in the presence of the financial directors of public utilities. Mostly they sit behind desks with glass tops. It is believed that they ponder over financial matters, and it is known that they figure with a slide rule and read New York financial journals which are not illustrated.

And who can doubt the value and influence of the general manager? The chief engineer keeps the physical plant in trim; the financial man provides the money, and the general manager co-ordinates these, and the result is a unit of service to the city.

Sometimes the general manager is even called to the home office for a conference, and if this does not indicate his importance, I don't know what proof anybody would require.

The engineer, the financier and the manager—useful men these, and responsible.

The Cost Of The Front Window

Now let us start this article—"The Girl at the Window."

For every patron who knows the engineer of the plant a hundred patrons know the Girl at the Window. Ninety-five per cent of the consumers will live in comfort and die in peace without ever being inside the plant, but 95 per cent of them know the front office and persons in charge there.

If you mention the light plant to a consumer, he will not think of the engineer, certainly not of the financial director or even the manager. He thinks of the front office.

Here is a matter for some thought.

When the price of coal goes up the engineer can measure the increased cost of operation accurately. When money is dear the financier can calculate its effect upon the company's operations.

I do not know how to measure exactly that reduced efficiency of a plant which can be caused by a mean disposition and a snippy tongue at the front window, but it must be considerable.

Front Office Appearance

The Girl at the Window will give the manager no peace until she gets a neat, clean front office.

Maybe not blue-veined marble and white tile and shining plate glass—soap and water and paint will help.

No wallpaper can stand constant exposure for more than ten years without giving way under the strain. If the county fair is over in July, the poster in the front office might as well come down shortly before Christmas. Some one ought to keep the wall calendar in the front office torn off to within ten days to two weeks of the true date.

In the public utility business there are two articles which never seem to wear out, cast-iron pipe and the blue window shades in the front office; but the pipe is buried in the ground, while the shades can be seen of all men.

Once or twice in a decade they should be turned bottom end to the top.

If there is a wall desk in the front office where people may write checks, the public pen should be changed annually.

It must be remembered that a patron writes such checks with great groaning of spirit at best, and if he is obliged to struggle with pasty ink and a rusty pen, by the time he gets to the front window he is far on the road to Bolshevism, and the most charming and courteous of girls will have a hard time to keep the peace with him.

There is a little front office down in Virginia which is a pleasure to remember. So clean, so bright and businesslike and wholesome, it was a fine setting for the very competent and charming young lady who, in Virginia, one would, of course, expect to meet.

If the company expects the Girl at the Window to help create and keep the good will of the patrons, don't handicap her by a front office which has the general color scheme of a waiting room of a flag station on a branch railroad line which is in the hands of a receiver.

Front Window Conversation

The Girl at the Window always remembers she is dealing with people at a time when they are engaged in the distasteful business of paying for a necessity.

A man who appeals to high heaven for relief against the extortion of a soulless corporation when he pays a three-dollar gas bill will stand in line for hours to pay ten dollars for a ticket to a prize fight.

This is perfectly right and proper and as it should be, and in the perfect state all necessities will be free and we can spend our money for luxuries.

I only call attention to the fine opportunity this gives the Girl at the Window to improve her disposition.

Anybody can get along with people when they are happy and cheerful and good-humored.

But in her dealing with scores of people of every degree, every day, when they are not especially gay or in a festive mood, she has an opportunity to develop that charm of pleasant, courteous personality for which there is room in every home or busi-

ness on this earth.

But if the Girl at the Window wishes to cultivate a sarcastic style of conversation, she will never have a better opportunity. Brilliant repartee, it is called in collegiate circles; bright, snappy stuff, at the ten-cent stores. It sounds funny in magazine stories, and people laugh at it on the stage.

She can ask a customer what he expects the company to give him for three dollars, anyway. She can tell him that she should worry whether he pays his bill or not.

She can tell the world that she is not there to hear all the grief in town, but only to take in money. She can ask the man who doesn't like the way we run our company what he is going to do about it. Bright, snappy stuff, we have said, and clever and original.

And so safe—for all the time she is behind her window and people can only pay and damn the company.

Or she can be a little more like that Girl at the Window down at Evansville. The other day the manager told me that she knew hundreds of patrons by name. He said she managed to slip in a friendly word with every receipt.

He told me that this girl had friends everywhere—from bank presidents to laborers.

This girl probably has a way with her. No doubt she is really interested in people and from her window looks out on a friendly world. I have noticed that friendly, happy people generally live in that kind of a world.

I gathered from my talk with the manager that the company intended to keep her as long as she would stay. I should think so.

What The Girl Should Be

The Girl at the Window is a business girl, and she knows it and looks it.

But, man of courage that I am, I can perhaps bring myself to a description of how she looks, but not how she achieves it.

If I were an old-fashioned person, this would be the place in this article for me to deplore the alleged fripperies, frivolities and transparencies of our girls.

But I am not an old-fashioned person. Anything but. And while my eyes are perhaps not so good as once they were, they have taken no injury from looking at the American girl.

But, just as I feared, I find I can only describe the impression she makes, not how she does it. She is that combination of trim, well-set-up and intelligent competence, plus a friendly, courteous charm of manner, which makes the modern American girl an important factor in business.

I have heard that there are two schools of thought among business girls as to the amount of information about the business which they should have.

One theory is that a girl needs to know only the one thing which she is employed to do and the boss has no business to expect her to know any more. I have heard that this is the view of many employees.

The other theory is that she should learn all she can of all sides of the business. I am told that this theory is held by many employers formerly employees.

The Girl at the Front Window is

not perplexed by this rivalry of thought, for she is obliged to know all about the business, or where the information can be had, in order to run her particular job.

One time, down in Alabama, I stood for a while by the front window, near enough to hear the talk.

It took far more knowledge of the plant than I had to answer the questions, but each patron got an answer of some kind. He either got the information he wanted or was told where to get it.

And she did not seem to take these questions and requests for information as a personal affront.

She actually gave me the impression that, in her opinion people were entitled to courteous consideration along with the privilege of paying their bills.

A good many people appreciate that kind of treatment.

The Girl at the Window will find that a general knowledge of the business will be no serious impediment to her success.

The chief engineer is a harried man who lives in fear of increased operating expenses. He works for increased efficiency at lowest cost.

Here the Girl at the Window has a distinct advantage, for she can reduce friction between the company and the consumers without spending a dollar more for oil.

She knows that it does not take any more coal to pump water or supply electrical energy to a satisfied consumer than to one who is mad.

In the whole operation there is no place where efficiency can be increased at less money cost than in the front office.

A Word Of Admiration

If I were writing this article to young men I would close with a few appropriate and well-chosen words of wisdom and advice.

But it is for the Girl at the Window, and no man living or dead ever added anything to his reputation for wisdom by giving admonition or advice to women.

If any girl reads this, she will take of it so much as she approves, first and properly remarking that no man who never stood one day behind a front window has any right to tell her about her business.

But if the Girl at the Window will have none of my advice, perhaps her repugnance to a word of admiration and appreciation is not invincible.

That is the purpose of this writing.

—Electrical World.

Showing An Interest After Obtaining Business

Many electric service companies will, when the question is raised, contend that they make every effort to show an interest in their customers after their application blank is signed, but the customers are not always so quick to agree with this contention. Actions speak louder than words, and to make its service as near 100 per cent. as possible the Georgia Railway & Power Company maintains a "greater service department." Four men are engaged in this department, which is really a field organization. They travel from customer to customer steadily, asking

whether the service is satisfactory, if not why not, whether all equipment or apparatus is in service, and so forth. A record containing definite questions of this character is filled in for each customer and turned into the sales department promptly for immediate attention.

Minor repairs like mending of flat-iron cord are made by the "greater service" representative, but major repairs necessarily are reported to the central office with other statements regarding service. The troubles are then adjusted by the electric service company or, if it is not the duty of the company to attend to them, the customer is informed how to get the work done.

In addition to the relatively detailed investigations of the greater service department representatives, the company has recently instituted a system of inquiry and investigation which is carried on coincidentally with the meter reading. As the reader enters the home he greets the lady-of-the-house with a "Good morning (or afternoon) Mrs. Blank" and makes inquiry as to whether the service is satisfactory and if not, in what respect it is deficient. When the reader reports back to the office in the afternoon he turns in reports of any complaints or requests for appliance adjustments. This innovation has served materially to improve customer relations and the time required for gathering the information has not appreciably increased the cost or time required for meter reading.

A great many prospects for gas and electric appliances are obtained in this way.

In the event apparatus, piping or wiring is found in a condition dangerous to life or property, or installed in such a manner as to be the cause of high consumption, a personal letter signed by the general sales manager is sent to the customer immediately after the visit, stating that the field man has reported that such and such a condition prevails and that same should be remedied.

The psychological effect of such methods alone, if no other advantage accrued, is worth the expense and time, says C. A. Collier, general sales manager. Furthermore, they prevent complaints accumulating and growing into general dissatisfaction that could only be eradicated with difficulty.

—Electrical World.

Follow Through

By J. K. SWANSON

Consumers Power Company, Jackson, Mich.

"GOING some, I'll say. Thanks for calling. I am with you."

"Mr.—, your Service Man, called yesterday and to-day your office 'phoned my wife to inquire if the water heater was O.K. This is real service. We want you to know that we appreciate this follow-up method."

"Hello, is this you, Mr. Hickman? You fellows at the Gas and Electric office are surely stepping on this 'Service stuff'. We expected you to take care of the complaint. We did not expect your man to drop in the following day to see if the washing machine was performing properly. Where did you get the idea? It's a good one. Working on this basis the town will be yours in five years. Such consideration is quite unthinkable coming from a Public Utility Company."

The originals of the above quotations are filed in our office together with hundreds of others just as complimentary. This unusual "come-back" from our customers is not the result of any expensive publicity department functioning through cleverly written and catchy appearing ads. in which attempts have been made to build up favorable sentiment and indirectly secure a friendly slap on the back. These remarks come from customers—our customers—who have actually felt the heart throb of a large Public Utility Company in a language which is perfectly understandable. Our advertising, on the whole, has been and is commendatory. Yes, even attractive, but in the final analysis more or less meaningless because we have not worked our story into the warp and woof of our daily experiences. In other words, we have been talking in advertising language which our customers do not take the time to understand. Why not save a large portion of this publicity expense and spend it in a more intelligent and personal manner and by more direct methods?

Have you not gone into hundreds of Public Utility Commercial offices and noticed neatly and artistically arranged and framed the words "COMPLAINT DESK?" So attractively were these words set up that if you had no idea of making a "complaint" you felt intuitively impassioned to do so in order to be accommodating. Have you not sat in a dozen or more conferences and been asked for a better word to convey to the public the purpose of this niche of space in your office known as the "Complaint Desk?" Have you not attended a dozen or more conventions and heard experienced men say, " See that shop orders on complaints are executed with promptitude and reported back

—completed. If you fail to do this your Company is not fulfilling its obligations to the public." One can almost hear the clank of the ball and chain by the austerity exposed in the speaker's manner of developing this subject. His motives were all right but his heart had become cold by years of automatic operating experiences. In other words, he had lost his personal touch with not only the public but also his own employees. They, too, had become mere automatons.

But why make such an arduous task of handling such a valuable asset, viz: "A complaint". There is not a word in the Public Utility man's vocabulary with which he can better afford to conjure than the word "complaint". Do not try to kill it. Do not even stifle or snub it. It is the very touch-stone upon which the Public Utility Company must eventually enter into its Promised Land. Nurture and feed it but, for heaven's sake, do not kill or smother it.

Have you not observed that the successful golf player has acquired the ability to "follow through" with his stroke? Did you ever see a well executed tandem play in a foot-ball game? Have you not been thrilled by the precision with which the quarterback followed through with his interference and advanced the ball several yards? In a base-ball game, have you not often seen the runner on first base caught out before reaching second, but regardless of that experience he followed through to second in order to complete the rules of the game?

Most assuredly you have—and yet, stop and think a moment: Do you know we have not been "following through" on this word "complaint?" Time and time again it has flung itself back into our faces because we have attempted to compel it to die an unnatural death. "Complaints" are eternal things. You cannot kill them. Any attempt to do so is suicidal. Stamping complaint orders "completed" does not put a parental touch into the transaction. The Public Utility Company from meter reader to manager who fails to see and understand this fact is not worthy of the confidence placed in him by his superiors. "Complaints" poorly executed have always been the Nemesis which has followed Public Utility operators and brought discredit upon them and their organization. Many men who are holding enviable positions as unusual operators are perplexed to-day because they find themselves slipping. Where is their trouble? Just one and only one place. That unassuming word "complaint" no longer is content to lie tabled in the shop. It has stepped out deliberately on the stage and insists on recognition—and quite naturally so.

The corner grocer, hardware and drug store proprietors handle "complaints" entirely different than was their practice ten years ago. The automobile service station, likewise, has forced a new meaning into the word. In fact, no wise operator of any line of business to-day ignores the consequences involved in relegating this word to a secondary place. Consequently, sort of unbeknown to Public Utility operators the old atmosphere surrounding the word "com-

plaint" has become offensive. Better living conditions have been provided for it in far less essential lines of industry, and quite naturally enough, the general public, as onlookers, have come to its rescue. They have forced its more serious recognition upon us.

Let us frankly admit our lack of foresight. Why not openly confess to ourselves that we have been altogether too "close-up" to our problems to actually sense our shortsightedness? We have taken years of past operating precedence as factors just as unchangeable as the law of Medes and the Persians. There has been and always will be a "complaint counter" or "service desk". The very nature of our business makes it mandatory for us to frequently meet our customers. They need our assistance. Then why not make "complaints" a part of our "quick assets?" It can be done.

Follow every complaint through. It entered your office at the so-called Complaint Desk either in person, by telephone call or letter. Why not be just as courteous by simply closing the transaction by the same personal touch? When the shop man or Service Department has properly taken care of the complaint, and the work order has been returned to the office, your responsibility toward your customer has just begun. Have these executed complaint orders turned over to one of your most competent clerks. That person will then proceed to 'phone every individual represented on the previous day's complaint orders to discover if the standard grade of service was rendered as reported, and if the appliance is working perfectly. This is the personal touch. This is the point of contact which is priceless. The plan itself is so simple in its operation that the results forthcoming are considered trivial and secondary. But stop and think a minute. Is there anything involving a better relationship with our customers which can possibly be considered trivial or secondary?

It goes without saying that the clerk assigned to this position must be high grade and well schooled in the art of handling the public. The voice also must be pleasing over the 'phone and possessing such mannerisms as beget a friendly feeling. In this simple and inexpensive operation you have done two distinct things for your company.

First, you have by word of mouth —never by letter—completed a perfect check on the service department. Secondly, you have secured the actual endorsement by word of mouth from your customer that he is satisfied. The customer will seldom, if ever, perjure his testimonial.

As simple as this operation may seem, it has in it the essentials for making lasting constructive public utility goodwill. It has been well said that a Nation that has no wars writes no history. It can, in turn be just as truthfully and forcibly said that a Public Utility Company which properly takes care of its complaints will not find it necessary to lean very hard or long on its Publicity Department or Public Relations Committees. "Follow through! !"

—A. G. A. Monthly.

Modern Hydraulic Turbines of Large Capacity

With Special Reference to Refinements in Design, Increased Efficiency, Improved Test Methods and Advances in the General Art which makes the Use of Large Turbines Possible

By H. G. ACRES

Chief Hydraulic Engineer, H.E.P.C. of Ontario

(*Continued from August Number*)

Efficiency:

The overall maximum efficiency of the Queenston units is well beyond 90 per cent, and within their maximum efficiency range they deliver about 32 electrical horse-power to the switchboard for every second-foot of water supplied under 305 feet of net head. Under such conditions a variation of one percent, one way or the other, on one of these 55,000 h.p. units, would mean either the lack, or the availability, of sufficient power to meet the requirements of an average community of 2,000 population. This statement should serve to emphasize the significance of high efficiency as related to super-turbine practice.

The primary factor making for high efficiency is a minimum of obstruction to the direct flow of water from forebay to tailrace. This consideration involves water passages of ample section, with changes in direction of flow eliminated wherever possible, and where unavoidable, careful proportioning and transitioning. These requirements constitute the general definition of high efficiency, and are exemplified in the carefully designed annular water passages in the Johnson valve, in the wheel-case, speed-ring, runner and draft-tube of the modern super-turbine, and also in the total elimination of one change in direction of flow entering the wheel-case, by vertically suspending the revolving weight from a Kingsbury type bearing. Secondary, but none the less significant factors, are the elimination of leakage, low power loss in thrust and guide bearings, and expert shop work.

The proper handling and co-relation of these various factors is ex-

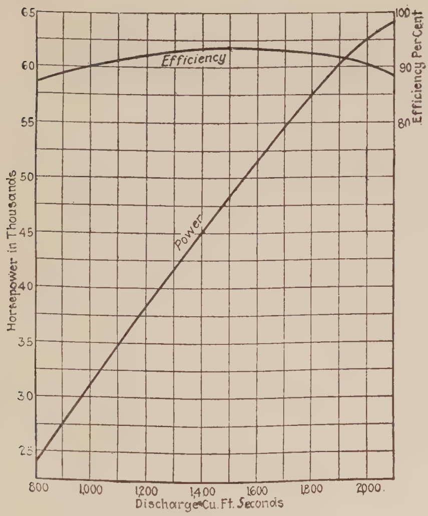


Fig. 1

emplified in the results illustrated in Fig. 1., which shows the efficiency and power-discharge curve for one of the Queenston turbines. The matters of interest in connection with these curves are as follows:

(1)—The maximum efficiency is 93½ per cent.

(2)—The efficiency at the point of maximum discharge is 88 per cent.

(3)—The turbine has a capacity range of 32,000 to 63,000 h.p. at efficiencies of 90 per cent, or over, and a capacity range of 37,000 to 60,000 h.p. at efficiencies of 92 per cent or over.

Fig. 2. illustrates the overall switchboard efficiency curve of the same unit, and indicates a maximum overall efficiency of 91 per cent.

The outstanding fact in connection with these results is that the modern super-turbine is capable of converting into mechanical energy all but 7 per cent of the gross potentiality of the water supplied. Extreme conservatism in the fixing of specific speed, and the combined effect of further small refinements in the design of water passages, may possibly raise this efficiency another percent in the future, and may give the curve a slightly more advantageous shape, but it would really appear that the super-turbine of the present day embodies the ultimate in respect of water economy at the point of best efficiency.

Fig. 3. is an interesting curve representing the first derivative of the power-discharge curve of one of the Queenston turbines.

As its name implies, this curve is derived by plotting the amounts of horse-power per second-foot produced, in various regions of gate opening at and beyond the point of maximum efficiency, by a very small opening movement of the gates. In other words it shows, not the gain,

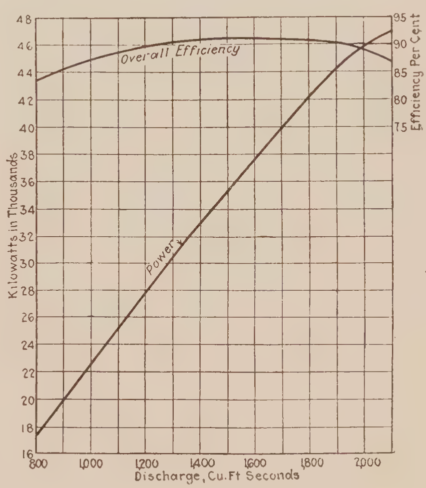


Fig. 2

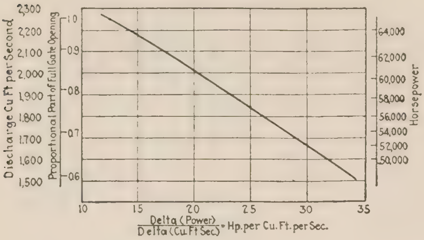


Fig. 3

but the rate of gain in power for increasing water input.

It will be seen that when operating at the point of maximum efficiency with a water input of 1,600 second feet, the gain in power for one additional second-foot supplied is 32 h.p. On the other hand, at full gate, when the turbine is taking water to the extreme limit of gate-opening, the gain in power for one additional second-foot supplied is only about 10.5 h.p.

The two extremes above cited serve to illustrate the significance of previous statements made under the head of flow control, and also to confirm the truth of the following statement: that under high heads, where the gross potentiality per second-foot of water is correspondingly great, it is in the best interests of economy, as well as safety, to operate normally at the point of best efficiency, and to employ the excess capacity of an over-gated turbine for emergency purposes only, and not for routine operation. This statement has an added significance, also, when the water supply is artificially stored.

Furthermore, it is obvious that as the point of maximum efficiency is also the point of minimum hydraulic loss, the rate of runner deterioration at this point must also be a minimum. From this point on, the rate of runner deterioration is an accelerating progression, directly related to the degree of over-gate.

The points in favor of gating the super-turbine back to the point of best efficiency are; first, safe and efficient operation, particularly where long pressure conduits are involved; second, economy in the use of water under high heads, where the gross potentiality per second-foot of water is great, and where artificial storage is a factor; and third, on account of runner deterioration, particularly where runner replacement involves a material revenue loss.

The matter of turbine gateage has not, in the past, received the attention it deserves at the hands of the purchaser. It does not particularly interest the manufacturer, and must be covered, if at all, by the customer's specifications.

It would also appear that the main factor offsetting the above argument is one of cost, and not of engineering; namely, the additional cost, if any, of providing emergency plant capacity in the form of a separately installed unit or units, instead of relying on the over-gate capacity of the normal installation.

It may be stated in conclusion that generalizations have probably less weight in hydraulic work than in any other branch of engineering, as nearly every prospective installation is a unique problem in itself, and no class of construction work is less governed by precedent.

Test Methods.

The factors entering into a turbine test are fore-bay and tail-water level measurements, net head measurements, records of gate-opening, and measurements of power and flow.

Most of these factors are susceptible of easy and accurate determination by well established methods, but in the case of flow, the immense quantity of water taken by the modern super-turbine introduces an almost unsurmountable problem as regards accurate measurement by ordinary means. It so happens, however, that there has recently been devised a method of flow measurement in closed pressure conduits, which by reason of its accuracy, cheap application, and conformity to an established principle of natural law, entitles it to be classed among the essential advances in the hydraulic art, as related to super-turbine practice.

This method of flow measurement, known as the Gibson Process, is based in principle upon Newton's second law of motion, and upon the less generally known theorem of Joukovsky, which is to the effect, that when the velocity of flow in a closed pressure conduit is retarded, an oscillatory pressure wave is induced, the intensity and amplitude of which is proportional to the degree of retardation, and to the duration of the period over which the retarding influence acts. Briefly, Gibson used the penstock and turbine gates to produce the Joukovsky pressure wave, which he recorded graphically with an apparatus of his own devising, and then reduced the result by the mathematical process of Newton's second law.

The method is therefore almost unique in the field of practical hydraulics, in that it involves no empirical constants whatever, and the mathematical accuracy of the result is limited only by a relatively small instrumental and personal error involved in graphically recording and measuring the pressure wave.

The Gibson Process has been fully described in the technical press, and it is not the intention here to cover the details of its theory or application. It may not be amiss, however, to describe briefly, the unique and interesting method of obtaining and using the "pressure-time" diagram which forms the basis of computation.

The recording apparatus consists of a mercury U tube connected to the penstock through a one-quarter inch pipe. The glass leg of this U tube is connected to a camera box containing a lens focusing on a light-proof cylinder, the latter carrying a sensitized film and revolving at constant speed behind an oscillating seconds pendulum. When gate closure occurs, the mercury column in front of the lens rises and falls with the pressure wave, and the record is printed on the revolving film. At the same time, the stem of the seconds pendulum, swinging across the face of the lens, records the

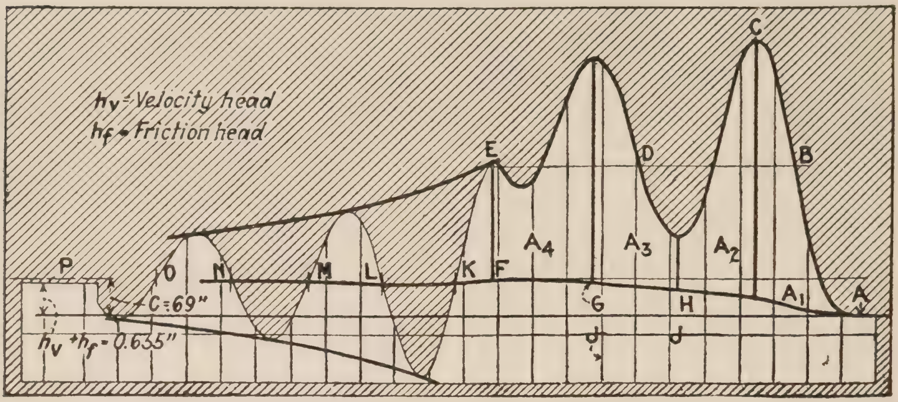


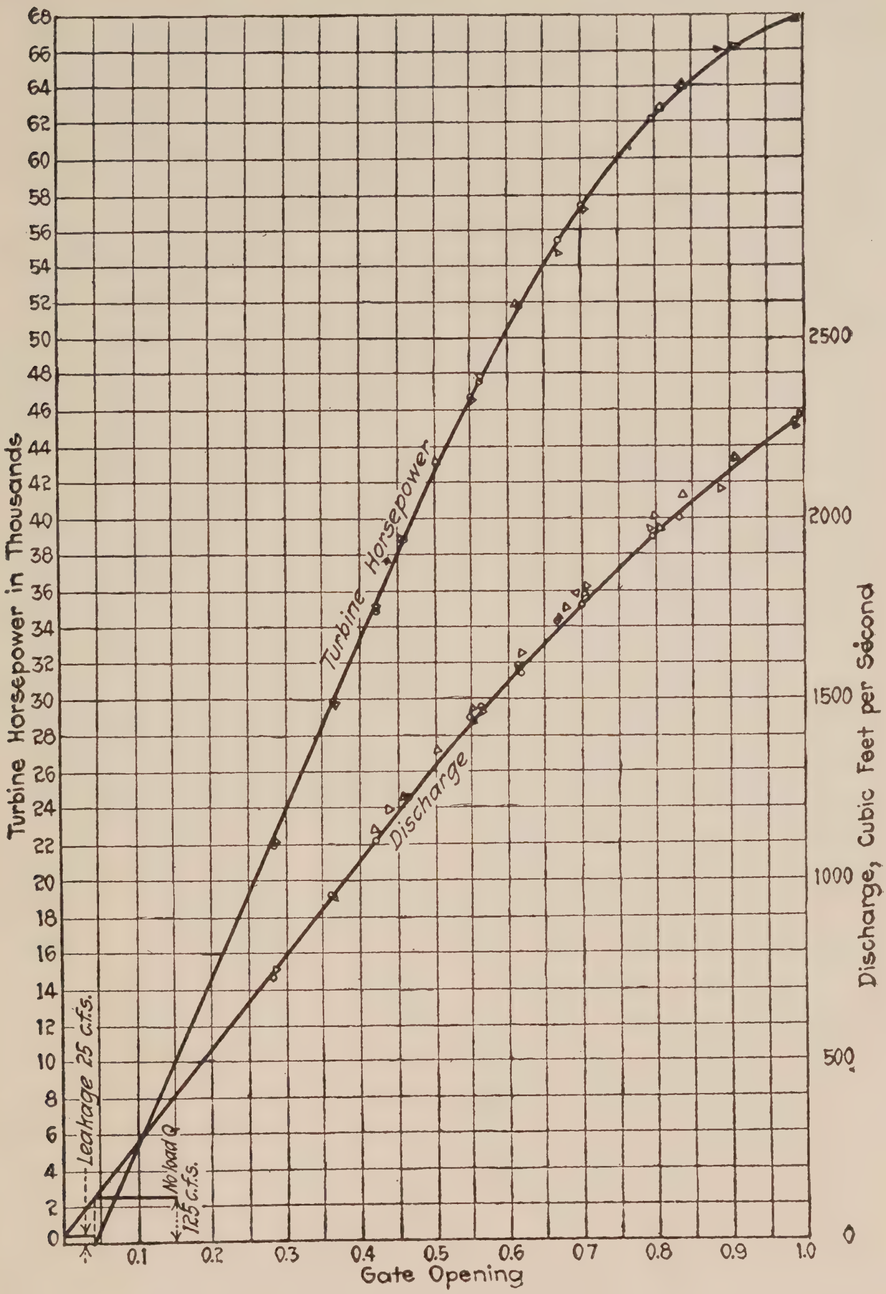
Fig. 4

time period of gate closure on the film, in the form of a vertical black line.

Fig. 4 illustrates a typical pressure-time diagram thus obtained. The point "A" represents balanced conditions in the system just previous to gate closure. The distance from "A" to the vertical line "EF" represents the full time period of gate closure. The oscillations to the left of the line "EF" are due to the mercury column gradually stabilizing by friction, until at the point "P" static head is registered, with the penstock water column at rest. The vertical distance between the point "A" and the point "P" therefore represents, to the scale of the diagram, the recovery of velocity and friction head. The lines "J" represent the second intervals recorded by the pendulum.

The total area above the base line, and to the point of gate closure at "F", represents a total energy absorption containing three separate elements, velocity head, friction head, and the destroyed momentum of the water column, This latter element being the one required for the application of Newton's second law, it follows that the energy absorption due to recovery of velocity and friction head must be segregated.

At the point "A" it is evident that the full value of velocity and friction head is existent, while it is equally obvious that at "F", the point of final gate closure, this energy has been fully recovered. The line AHGF, technically known as the "recovery line" divides the total energy area into two parts, the upper part of which A,B,C,D,E, F,G,H, represents the value sought, namely, the destroyed momentum of the water-column. The area below the recovery line of course represents the sum of the other two elements, friction and velocity head. Intermediate points between "A" and "P" on this line are obtainable through the fact that the area generated at the end of any partial period of gate closure is proportional to the amount of flow


Turbine Horsepower in Thousands
Discharge, Cubic Feet per Second
Gate Opening
Turbine Horsepower
Discharge
Leakage 25 c.f.s.
No load Q
125 c.f.s.
0
2
4
6
8
10
12
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500
1000
1500
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2500
0.1
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0.3
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0.5
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0.7
0.8
0.9
1.0

Fig. 5

reduction at that point, and also that the velocity and friction heads still unabsorbed are proportional to the square of the residual flow. The intermediate points "C" and "H" were determined on the basis of these relationships, through the medium of the measured sub-areas A1, A2, A3, and A4.

Fig. 5 illustrates a gate-opening power and a gate-opening-discharge curve for one of the Queenston units. These curves are interesting in that they were compiled on the basis of two simultaneous but entirely independent series of measurements, in different sections of the penstock, by the Gibson Process. The round dots on the curve represent the determination of Mr. Gibson himself, with his own assistants, and the triangular dots represent the determinations of the engineers of the Hydro-Electric Power Commission. The close agreement of these two series of discharge measurements affords striking evidence of the remarkable consistency and precision of the Gibson method of discharge measurement.

This test, with all the other necessary operations in connection with head and gate-opening measurement, etc., was made complete within about four and one-half hours, and included 28 separate runs at various gate openings, an average of ten minutes per run. The unit itself was out of commercial operation for about one hour altogether, showing clearly the facility and cheapness with which the Gibson test can be carried out.

An interesting feature of these tests manifested itself in an apparent inconsistency in some of the finally computed points for the efficiency curve, which varied for equal power outputs. This trouble was due to a discrepancy in the power readings, which were actually correct in themselves within the error limits of laboratory standards. The reason is that under the Gibson method the velocity measured is that existing at the instant the gates begin to move, and if the speed of the unit is perfectly uniform at this instant, the corresponding power reading will be correct for the measured discharge. If, however, at the instant of the flow measurement, the unit is in process of a speed change even so small as to be unnoticed on the frequency meter or tachometer, an error will be introduced in the electrical power measurement which the Gibson process is sufficiently precise to detect.

The fly-wheel effect of the Queenston generators is 21,000,000 foot-pounds squared. If, at the instant of a flow determination, the speed of the unit is dropping at even so small a rate as one cycle in ten seconds, there is 570 h.p. registered on the watt-meters which the "wr^2" of the generator is supplying, but not the water as measured.

Conversely, if the speed of the unit is in process of increase at the rate of one cycle in ten seconds, there is 570 h.p. which is not being registered on the watt-meters, but which the water, as measured, is

actually supplying, for absorption by the generator "wr^2".

This means that for any one value of discharge there may be any number of watt-meter measurements which may possibly be in error in any amount up to 1,000 h.p. It is possible that this disability may be overcome by devising some simple means of recording the minute speed change of the unit synchronously with the instant of flow measurement, and thus permit a proper correction to be applied to the power readings.

The use of the Gibson Process is naturally limited to conditions which are properly conducive to the production of the phenomena upon which the theory is based, the first essential being a closed pressure conduit of reasonable length and uniform section. In short conduits of say 50 to 60 feet in length, more especially if they have at the same time a non-uniform section, it becomes necessary to apply correction factors which have a greater relative influence on the ultimate accuracy of the result than is the case with long conduits of uniform section. It so happens, however, that the recently devised Allen "salt-velocity" method of measuring flow is susceptible of application to short as well as long conduits and to non-uniform as well as uniform sections, the accuracy of the final result being dependent, not upon an instantaneous pressure rise, but on the refinement of method and money outlay applied to the injection of a salt solution, the time of passage of which, through a fixed length of conduit, forms the basis of the final computation.

The writer is not sufficiently familiar with this method to attempt a detailed description, but recent practical applications of the same appear to indicate that the Allen "salt-velocity" method of flow measurement has a really useful function and will become a generally recognized process as related to this branch of hydraulic engineering.

In conclusion, it may be well to call attention to the fact that the definition of a turbine of large capacity, as given in the preamble of this paper, is applicable in particular to the Francis type, as there are now in operation, under heads of less than 70 feet, super-turbines which would come within the definition as regards capacity and revolving weight. These turbines are, however, of the new propeller type and any discussion of this new departure in turbine design would open up a subject far beyond the scope of this paper.

In evidence before the International Joint Commission, two years ago, the writer advocated the propellor type turbine for the St. Lawrence River Development, and was subjected to severe criticism for so doing. However, recent performance, under actual installation conditions, has confirmed his views to a large extent, and it is more than likely that the St. Lawrence River Development, when consummated, as it ultimately must be, will see the propeller type turbine installed.

It will be noticed that in the above discussion all names have been mentioned in the impersonal sense. This was done designedly as a compliment to the eminent coterie of engineers who have been largely responsible for the high status of the hydraulic art is it exists to-day. These men have wrought with a source of power in nature which will be vastly more beneficial in its ultimate impress upon our civilization than has been, or will be, the case as regards our non-replenishable energy resources. The names of Watt, Stevenson, Corliss and others associated with the age of steam, do not now stand before us as definite personalities, but rather as symbols typifying a great service to humanity. Fifty years hence, the same impersonal significance will attach to the names of those who to-day have brought so near to perfection the mechanisms necessary for converting the raw potentiality of falling water into an essential commodity.

Walt. Mason on Electric Lighting

"When in my cozy room o'nights I count my blessings every hour; I push a button and the lights shine forth with potency and power. Last night the button failed to work, some dynamo had broken down, and midnight shadows seemed to lurk o'er all the sore and saddened town.

"My aunt produced an ancient lamp, with misfit glass and shade of green, and its exterior was damp with evil smelling kerosene. I cranked it up and lit the wick, and said 'Now we shall have some light,' the smoke it sent forth dark and thick, increased the blackness of the night. When turned too low it gave no light, when turned too high it acted drunk: and I exclaimed, 'Confound the wight who ever made such hopeless junk.'

"I fooled with it in my abode, neglecting more important chores and in the end saw it explode, and blow my aunt clean out of doors. My clothes were wet with kerosene, my hide was full of glass and neighbors say they wist and ween my language shriveled up the grass.

"Our fathers used such dizzy traps to light their homes and thought them great, and much I fear we modern chaps don't realize our rich estate. I count my blessings, count them all, since with that coal oil lamp I wrought; I press a button on the wall, and lo, the light to me is brought."

—The Synchronizer.

Hydro News Items

Central Ontario System

Mr. C. T. Barnes has been appointed Local Manager for the Hydro-Electric Power Commission of Ontario at Oshawa, following the resignation of Mr. A. T. Hicks.

* * *

Construction is proceeding on a sub-station and single phase feeder to supply the village of Warkworth with service. The contract calls for twenty-five horse power.

* * *

On August 19th, the distribution voltage at Bowmanville was changed from 2400 volts delta to 4160/2400 volts Y. The cut over of the entire town was completed in one day, without any mishaps.

* * *

Eugenia System

The construction of a transmission line and sub-station covering service for the Town of Meaford has been authorized by the Commission and arrangements have been made to start the work immediately. Approximately sixteen miles of 22,000 volt three-phase line will be required from the nearest point on the Eugenia-Severn tie line to the town sub-station. Every effort will be made to complete the line and station so that both may be placed in operation early in December.

* * *

Niagara System

The Commission recently approved of Etobicoke Township Hydro-Electric System spending up to $15,000 in connection with the construction of a suitable office building for Hydro purposes.

* * *

The Village of Jarvis recently passed Hydro Enabling and Money by-laws, and arrangements are under way to construct the necessary lines to the Municipality. It is expected that service will be available in the Village about December 1st.

* * *

The Village of Courtright has recently signed a contract with the Commission for power supply, and the construction of lines to supply the Municipality will be undertaken in the very near future.

* * *

The Municipality of Cayuga will vote on Hydro Enabling and Money by-laws in the near future. Cayuga is one of the oldest Towns in this district, but owing to plentiful supply of cheap gas, hydro service has not, as yet, been extended into the district.

* * *

The Villages of Blyth and Brussels will vote on Hydro by-laws within the next few weeks, and they have already secured the promise of enough contracts to place the distribution systems in each Village on a paying

basis from the commencement of operation. It is expected the by-laws will carry with substantial majorities.

* * *

Nipissing System

Considerable progress has been made on the construction of the new development at Bingham's Chute on the South River near Powassan. The dam is nearly finished and the rock excavation for tail race, pipe line, and power house foundation is just about completed. The construction of the Diesel oil engine auxiliary Station at North Bay is also progressing. Every effort is being made to have these two plants operating by the first of next year.

* * *

Ottawa System

A large lumber mill in the Nepean Rural District is proposing to take 50 h.p., and estimates have been prepared to supply this amount of power.

* * *

Rideau System

In the recent action of the Kemptville Milling Company vs. the Village of Kemptville, the judgment was given in favour of the Village, and they were awarded $500 on a counterclaim. The Kemptville Milling Co. has now given notice of an appeal against this judgment.

The case has an important bearing on the rights of a private Company to occupy the public streets of a municipality.

* * *

The Municipality of Almonte has suffered severely through fire. The extent of the damage is not yet known, but the electric light plants are reported to have been severely damaged.

* * *

Messrs. Findlay Bros., of Carleton Place, showed two samples of their new electric range at the Toronto Exhibition. They are also exhibiting at the Ottawa Fair.

* * *

St. Lawrence System

An additional power load of 15 h.p. has been obtained in Maxville to operate a chopping mill.

* * *

The Maple Leaf Milk Company have installed additional motors in their Chesterville plant.

* * *

A public meeting was held recently in Bainsville to submit information on the cost of service to residents of Bainsville and rural residents of Lancaster Township. Bainsville is in Glengarry County, about 3½ miles from the Western boundary of the Province of Quebec.

* * *

Petitions have been received from residents of Cornwall and Kenyon Townships requesting estimates on the cost of rural service.

* * *

Estimates are being prepared on the cost of delivering 3000 and 4000 h.p. to the Town of Hawkesbury.

* * *

Thunder Bay System

An extension to the Commission's development at Cameron's Falls on the Nipigon River is now under construction. The Power House building is be-

ing enlarged to provide for two additional generating units and an additional bank of transformers as well as providing space for all of the requisites in the nature of auxiliary equipment. This extension will double the capacity of the present development and will give the Commission approximately 50,000 h.p. from the completed plant. It is the intention of the Commission to perform as much of the work as possible this Fall, and complete the job in the Spring. The route of the second transmission line to Port Arthur is also being surveyed and provision is being made to have this line ready for service at the same time as the new extension to the development.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in August 1923.

Appliances

National Equipment Company, Limited, 1 Wabash Ave., Toronto.

Automatic Water Pumping Equipment.

* * *

Milvan Trading Co. (Submittor), 12 Queen St.,E., Toronto.

Stahot Electric Incorporated, (Mfr.) Yorkton Heights, New York.

"Stahot" Flat Iron.

* * *

Hydro-Electric Power Commission Of Ontario (Submittor), Sales Dept., Toronto.

Renfrew Electric Products Limited (Mfr.) Renfrew, Ont.

"Hydro" Flat Iron.

* * *

Superior Electrics Limited, Pembroke, Ont.

Table Stoves, with length of heater cord and separable attachment plug, Cat. No. 51; with heater cord and tandem attachment plug cap, Cat. No. 52.

Urn Heaters, Cat. Nos. 53 and 54 respectively.

* * *

Home Appliances Mfg. Co. Limited, 382 Nairn Ave., Winnipeg, Man.

"Community" Washing Machine.

* * *

Niagara Electric Co., 325 Beech Ave., Toronto, Ont.

Mantel Grate, Type I-10.

* * *

*California Fruit Growers Exchange, 154 Whiting St., Chicago, Ill.

Portable Fruit Juice Extractor.

* * *

Fittings

The Brunt Porcelain Co., Columbus, Ohio.

"Brunt" Porcelain Tubes, Bushings, Knobs and Cleats.

* * *

The Mogadore Insulator Co., Mogadore, Ohio.

"Mico" Porcelain Bushings, Knobs, Tubes and Cleats.

Hessco Electric Manufacturing Company, 65 Frederick St., Toronto, Ont.

"Orpen" Medium Base Sockets, Cat. No. 350.

* * *

*Roach-Appleton Mfg. Co., 2446-56 N. Crawford Ave., Chicago, Ill.

Switch Boxes, "Raco" Types BL, BLC, MC, RM and RS.

* * *

*The L And N. Co. Limited, St. Johns, Quebec.

Armored Cable and Flexible Steel Conduit "LN".

* * *

Switches

National Equipment Company, Limited, 1 Wabash Ave., Toronto, Ont.

Automatic Switch, Type No. 8A.

* * *

Fixtures

Kimble Electric Company, 634-646 North Western Ave., Chicago, Ill.

Auto Transformer Starter and Controller.

* * *

Canadian Manley Mfg. Co., c/o The Brown, Boggs Co., Limited, Hamilton, Ont.

"Manley" Portable Stand for Garage Lamp, Cat. No. 700.

* * *

Miscellaneous

Caron Brothers, Inc., 233 Bleury St., Montreal, Que.

Electric Lighting Plant.

* * *

Canadian Car And Foundry Company, Limited, 307-309 Craig St. W., Montreal, Que.

"Berwick" Electric Rivet Heaters, Type Nos. 1,2,3 and 4.

* * *

*Forest Electric Co., 50 Columbia St., Newark, N.J.

Rectifiers, "Unitron".

* * *

*Monowatt Electric Import Co., Inc., 546 Broadway, New York, N.Y.

Christmas Tree Outfits, "Monowatt Cheer-i-light", "Solite".

* * *

*Canadian Fairbanks Morse Co. Limited (Submittor), 26 Front St. W., Toronto.

Fore Electric Mfg. Co. Inc. (Mfr.), 5255 N. Market St., St. Louis, Mo.

Vibrating Rectifier, Type 1A.

* * *

*Allsteelequip Co., Aurora, Ill.

Cabinets and Cutout Boxes—Sheet Metal.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

THE BULLETIN

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CONTENTS

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OCTOBER, 1923

An Appreciation

Measured by terms of cost, there is probably nothing that brings so large a return as courtesy and fair treatment. That these things are still appreciated by men of affairs is shown by the following letter recently received by the Commission from the President of the Holland Varnish Company.

Montreal, June 6, 1923.

Hydro-Electric Power Commission.
Toronto,
Ontario.

Gentlemen:

In your letter of May 30th you mention that you have noted the address to which my bills will be sent in future, instead of having them go to South Lancaster. You tell me that you will deduct the discount which I was unable to take, from my next bill.

May I say that the unusualness of this treatment is all the more appreciated in view of the fact that it comes from a Public Utility Corporation. We are all too prone to think of the publicly owned corporations as not caring particularly what their customers think of them, and it is a great pleasure to have this evidence of the interest of your particular Commission in its customers.

Treatment such as this cannot help but reflect itself in the relations

between the Commission and the power users, and I have no doubt that this type of treatment goes far towards explaining the high regard in which I find your Commission is held throughout Ontario. Our service at Lancaster has been extremely satisfactory and you will undoubtedly be interested in knowing that my consumption of power will be quite heavy for a private residence.

Yours truly,

(Signed) Norman Holland.

The Hydro-Electric Power Commission of Ontario

Extracts From Address By Sir Adam Beck

At the Public Ownership Conference at Toronto, September 13, 1923

THERE are certain features which must lie at the foundation of any movement such as that carried forward by the co-operating municipalities of the Province of Ontario—if such a movement is to succeed. First of all, there must be a genuine desire on the part of citizens to have electrical energy, or whatever the commodity may be, supplied to them under such conditions and circumstances as would prevail under public ownership.

The men who undertake to found a publicly-owned enterprise, especially during its initiatory stages, should be responsible and prominent citizens of good business standing and character, who will inspire and hold public confidence. Such men must be willing to make sacrifices on behalf of the new programme; for just as soon as it is perceived that matters are being undertaken in a serious and successful manner, just so soon will opposition begin to assert itself from various antagonistic sources. Courage, perseverance and other qualities will be called into action on the part of those who are standing sponsor for the new undertaking.

The necessary financial resources should be supplied by the people who will themselves benefit from the undertaking. Financial resources are required, even for the preliminary researches and investigation of the problem in hand. When the people begin to invest their own money in an enterprise, this procedure of itself arouses and assists to maintain interest.

Technical men of sound engineering, financial and other training must be engaged who will, with singleness of purpose, gather the

facts and assist in forming sound judgment, based upon the data secured. Later they will be found guarding, directing and operating the publicly-owned utility.

Throughout the whole proceedings, the general public must be taken into confidence and kept adequately informed. As opportunity offers, the citizens should be educated to understand the general character of the various problems under consideration. In a word, unless there be a desire on the part of the citizens of a community to proceed on a basis of public-ownership; unless there be responsible and qualified public men ready to make sacrifices to achieve the results desired; unless competent technical assistance be employed, and unless the people themselves are ready to back the project with their financial resources, there is not, in my judgment, any satisfactory basis upon which to initiate and carry forward to a successful conclusion a programme of public ownership.

From time to time, the Commission has received enquiries from various sections of this and other continents, requesting information respecting the operations of the Hydro-Electric Power Commission of Ontario. It is evident from many such enquiries that the enquirers entertained a hope that they would receive detailed knowledge of the operations of the municipally-owned hydro-electric undertaking in Ontario in such a form as would enable a similar project to be carried out in their own community. Some appear to forget the fact that each situation requires to be studied on its own merits, and the various essential factors properly evaluated before deciding upon what particular features of administration shall be adopted. In the case of this Commission many changes have had to be made in statutory enactments, regulations, rules and other items appertaining to the Commission's administration. A competent staff will soon discern where enactments are inoperative and how modifications may be effected.

I have been led to comment as I have been doing, because it is all-important to realize that certain basic circumstances and certain fundamentals of procedure must obtain if any movement such as that of the Hydro-Electric Power Commission of Ontario is to be initiated with any promise whatsoever of ultimate success.

Having made these observations, permit me now to turn to some of the achievements of the Hydro-Electric Power Commission of Ontario, and as these are set forth I believe you will readily discern the pertinence of the general comments which I have just made.

Early Conditions Which Prompted the Initiation of "Hydro."

At the beginning of this century there were increasing evidences that the central portion of Canada was destined to become an important centre for manufacturing industries. The Province of Ontario possesses many natural advantages and compares most favorably with any large areas of territory found elsewhere. Its important natural resources of

agriculture, including fruit-growing, of forest wealth and mines, supply raw material for an extensive and growing manufacturing industry. It was recognized, therefore, that there were possibilities for an increased export of farm and manufactured products, and that there was no reason why the Province of Ontario—especially with an adequate supply of power—should not take a prominent place in world commerce.

It had become widely recognized that the growing dependence of the Province of Ontario upon outside sources for its fuel supply constituted a menace which it was greatly desired to remove, especially in so far as the coal requirements for the development of power were concerned. A number of public-spirited citizens impressed with the urgent necessity for directing their effort to the problem of utilizing the large water-power resources of the Province—more particularly Niagara Falls—as a means of accomplishing the extensive replacement of coal for the generation of power in Ontario, applied themselves to the solution of this problem.

It was in 1900 that a special committee of the Toronto Board of Trade made a report directing attention to the possibilities of securing an abundant supply of hydro-electrical energy from the Niagara river, There were, at this time, in many of the municipalities of Ontario, citizens who had recognized the desirability of securing adequate supplies of electrical energy for both power and light at low cost. These citizens were studying the problem and were ready for co-operative action once a suitable scheme was formulated.

Public Interest Leads to Government Action.

The interest manifested in the power problem increased and was greatly stimulated by means of public meetings, and by discussions in the Press. Appeals were made to the Provincial Government for legislation to enable municipalities to take action, and finally, as a result of the general movement on behalf of cheaper hydro-electrical energy, the Government of Ontario, in 1903, provided the means by which a Commission could be appointed by interested municipalities to investigate and report upon questions involving the supply and distribution of hydro-electrical energy.

The authority thus granted resulted in the appointment by the municipalities of Toronto, London, Brantford, Stratford, Woodstock, Ingersoll and Guelph, of the Ontario Power Commission, which, after a thorough investigation, published in 1906, a comprehensive report dealing with the matters which had been referred to it. In this report, the availability and costs of power from the primary sources of coal, gas, oil and water were set forth, also data respecting the consumption and estimated future requirements of power in the districts concerned, the cost of the development of Niagara power, and other relevant matters.

When the results of this investigation became known to those inter-

ested, and even before the report was available for public distribution, the Provincial Government, in 1906, provided by special Act for the creation of the Hydro-Electric Power Commission of Ontario—the organization now in existence. In 1907, further legislation was passed strengthening and extending the powers of the Commission. One essential difference between the Act of 1903 and the later Acts of 1906 and 1907 is, that under the 1903 Act various municipalities could combine into separate groups operating through separate commissions, whereas provision is made in the later Acts whereby all municipalities appeal to the Hydro-Electric Power Commission of Ontario and make known their wants. The Commission is thus able to harmonize their various requirements and co-ordinate the municipalities into suitable groups or districts. In 1908 by-laws were passed by thirteen municipalities authorizing their officials to make contracts with the Commission for a supply of electrical power from Niagara Falls.

Financial Structure of "Hydro."

Certain principles, which the inaugurators of the "Hydro" undertaking believed sound, were laid as a basis upon which to administer the various assets in which the municipalities are concerned. These underlying principles briefly expressed are as follows:

First: The generation and transmission of power on a wholesale scale is dealt with by a Commission which, although appointed by the Government of the Province, acts independently in the capacity of trustee and agent for the partnership of municipalities.

Second: The local distribution of electrical energy within the borders of a municipality is, in general, under the administration of a public utilities commission appointed under the provisions of the Public Utilities Act.

Third: Capital required for the plant for the generation and transmission of power is provided by the Government upon receipt of formal requisition from the Commission. Contracts are entered into between the Commission and the municipalities under the terms of which the municipalities undertake to repay in thirty years the moneys thus loaned by the Government.

Fourth: The local distribution system is financed by the issue of municipal debentures. Provision is made in the rates charged to the ultimate consumers for revenue with which to retire these bonds also, usually in twenty years.

Fifth: The "trustee" Commission supplies power at wholesale rates to the municipalities, charging each municipality the actual cost. To do this, an interim charge is made monthly, based upon the estimated cost, and, at the end of each year, credit or debit adjustment is made of the amount charged in order to make up the actual total cost—no more and no less. The "cost of power" includes all the usual costs of operation and maintenance of the generating, transforming and trans-

mission plant and equipment, and, in addition, the annual interest charges on the moneys borrowed for the initial cost of installation, also provision for renewal (depreciation) and sinking fund reserves, as well as a special reserve fund for contingencies.

Sixth: Each municipality sells electrical energy to its own local consumers at rates and under conditions approved by the Commission. The rates charged to its own consumers by a municipality are made sufficient to take care both of the cost of distribution, within the municipality, and of the estimated cost of power to be paid to the Commission by the municipality. The cost of distribution is ascertained in a manner identical with that used by the Commission in arriving at its wholesale costs.

Seventh: Under the Power Commission Act, the Commission is required to determine, annually, the actual cost of service supplied to the municipal corporations by the local commission for such strictly municipal purposes as street lighting, street railways and operating electric-motor-driven pumps in waterworks, and if any profit has accrued through the charging of the rate used throughout the year, this surplus is handed back to the municipality.

If a municipality desires to obtain a supply of power from the Commission, a vote is taken at the polls, and if the result be favorable an enabling by-law is passed whereby the municipality is empowered to make a contract with the Commission for the amount of power required. The Commission's engineers are at the service of the municipality to enable a reasonable estimate of the requirements to be made. The contract having been duly executed, a money by-law must then be passed authorizing the Municipal Council to issue the debentures necessary to cover the cost of constructing a local distributing system within the limits of the municipality; the Commission then proceeds with the work of building the necessary transmission lines, sub-stations, etc. The municipalities repay the cost of the project out of earnings, spread over a period of thirty years, all such items as maintenance, depreciation, and sinking fund being fully taken care of. At the end of thirty years' time the entire plant and equipment will belong to the municipalities and thus the people will eventually be the owners of a fully paid-up undertaking.

The basic principle of the whole "Hydro" project is a partnership of municipalities formed to obtain power at cost, each municipality paying its proportion of the cost of the service received. The Commission, acting as agent and trustee for the municipalities, exercises both administrative and constructive functions, and by application of the principles just mentioned, has evolved a well-defined and successful working policy for the development, transmission and distribution of hydro-electric power under municipal ownership.

Rural Distribution

I should like here to make a brief reference to some of the results achieved by the Hydro in bringing to small communities and to individual farmers the inestimable advantages of electrical service. In no way is the difference between private and public ownership of electric utilities more strikingly shown than in a comparison of the services rendered to the smaller communities and rural districts.

The difficulties of electrification of country districts are universally recognized. Generally speaking, from the viewpoint of the central station this class of consumer is unprofitable. Only a small return can be secured on any capital invested. The operating costs due to the distances to be covered, are excessive. The load per mile of distribution is small—compare, for example, the number of services connected in a mile of city streets and to a mile of rural line. The load factor is low and the demand irregular, being controlled in part by weather conditions which affect most farmers in a given locality in a similar manner. Farmers often use machinery larger than is really necessary for the work they have to do. When the work is performed electrically it may often be done more profitably by smaller machines taking less power to operate.

In spite of the handicaps inherent in rural distribution of electrical energy, the Hydro-Electric Power Commission has made substantial progress in this department of its activities. Its first rural lines were built late in 1912, but in 1917, the construction of rural lines was suspended, due to the high cost resulting from War conditions. The legislation enacted in 1911 to meet the conditions of that period which consisted, so far as rural service was concerned, of requests from groups near urban centres, was later found to be inadequate, and, in 1920, was amended to provide for conditions then obtaining. Under this amended legislation, zones or districts are determined in which electrical service is given to each of certain specified classes at the same rates throughout the whole district based on average conditions in the district. The boundaries of such districts are not arbitrary geographical limits, but depend upon the economical distances which may be served from a distribution centre of city, town or village.

The total mileage of rural lines at present operated by the Commission is 835 miles, giving electrical service to about 13,500 customers.

Although the aggregate load distributed to the rural dwellers is, and must always be, but a relatively small proportion of the energy distributed by the Hydro, its influence upon the economic life of the Province of Ontario will doubtless be far-reaching and is already a factor of importance. Agriculture still ranks as the most important of our industries and in these days with farm labor scarce and expensive, anything that takes its place is a great help to the farmer, for, as is universally

acknowledged, upon him in the last analysis rests the prosperity and welfare of the community.

If the distribution of electrical energy in Ontario had been in the hands of private corporations, most of the thousands of customers in rural Ontario, including the smaller towns and villages, to whom the Hydro now distributes electricity, would still be without the benefits of electrical service. Except where heavy loads are obtainable—as for example in the irrigation districts of California—the rural consumer is usually unprofitable and companies will not consider extending their lines to such customers.

The policy of the Commission has been, and is, to give the widest distribution of power consistent with possible limiting costs. The energies of its engineers have been directed to ascertaining the most economical methods of rural distribution. Much pioneer work has already been undertaken and the results achieved have more than justified the efforts.

The Future of "Hydro" Full of Promise.

In concluding, I should like to say a word with respect to the probable future demands upon the Hydro-Electric Power Commission of Ontario.

Commencing in 1910 with an initial load of less than 1,000 horsepower, this increased until in 1915, that is within five years, the Commission reached the limit of its first contract with the Ontario Power Company for 100,000 horsepower, while to-day, including exported power, the Hydro-Electric Power Commission is distributing about 650,000 horsepower.

Since the inauguration of the Hydro there has been purchased on behalf of the co-operating municipalities no less than twenty-two water powers, thirty hydraulic generating plants, and over sixty electrical distribution systems. At the present time, the Commission operates electrical power undertakings which, when fully developed, will have an aggregate capacity of 1,000,000 horsepower.

Notwithstanding these provisions, the Hydro-electric systems administered by the Commission—including the Niagara system—are practically all face to face with an oncoming power shortage. It is true that this is not the case, as yet, with Nipigon development at the head of the Great Lakes, but even here it will not be long before the available power will be requisitioned.

It should be appreciated that this phenomenal growth in demand of electrical energy for power and light has continued even during a period when industry has not been expanding as it was prior to the Great War. The demand for hydro-electric energy, in the Niagara district especially, has been increasing at a phenomenal rate. This has been brought about chiefly by increased demands for general domestic and commercial purposes. In the last two or three years a new impetus was given to the building trades, entailing a substantial addition to the lighting load, both for premises

and street purposes.

In a word, if, during the period when general industrial activity has scarcely reached normal, there has been a demand for electrical energy for general purposes such as to absorb the available supply, where is the electrical energy to come from in order to meet the large demands of expanding industry which so many far-sighted citizens, both in the United States and the Dominion of Canada, believe must come in the very near future in order to supply the world demand for manufactured commodities?

Chief Sources for More Electrical Energy.

The answer to this question of where the power is to come from is, that there will be no place for this power to come from unless provision is made immediately to develop large new sources of power supply.

What, then, are the chief sources for additional power supply? For southerly Ontario, extending, say, from Windsor on the west, to the Quebec boundary on the east, the two chief sources of power supply are the Niagara and the St. Lawrence rivers.

So far as the easterly portion of the Province of Ontario is concerned, there is an abundant potential supply of hydro-electric energy on the St. Lawrence river in the vicinity of Morrisburg and at the Long Sault rapids. This is the international boundary portion of the St. Lawrence river. Various engineering projects for the development of the St. Lawrence have been suggested; some by our own engineers, some by engineers in the United States, and some by the International Joint Commission. It is not my intention to discuss details. It is the opinion of all concerned that irrespective of what particular project is decided upon, the St. Lawrence river may be developed in the combined interest of navigation and of the water power of both countries, —the Dominion of Canada and the United States.

The Province of Ontario owns a fifty per cent. interest in the power in the international portion of the St. Lawrence, to which I have referred, and this half share amounts to over 800,000 horsepower. The other half, of over 800,000 horsepower, is owned in the United States.

Co-operation Required for Action Respecting the Development of the St. Lawrence.

The people of the Province of Ontario are ready to co-operate with other interests in this great undertaking, provided, of course, that Ontario's rights to the full benefit from the development of her share in international waters including of course, her water powers, are not jeopardized.

You know it takes several years to initiate and construct the works and commence the transmission of electrical energy from these large hydro-electric plants. Where would the Province of Ontario be to-day if, prior to the year 1910, Ontario municipalities and the Hydro-Electric Power Commission had not foreseen the possibility of greatly

expanding power markets and had not provided for the present heavy demand by initiating and constructing the new Queenston-Chippawa plant?

The circumstances when the Queenston-Chippawa plant was contemplated were not of the same magnitude, nor did they appear to be so pressing as they are to-day. Present conditions indicate a power shortage which, probably, cannot be entirely avoided. In fact, drastic measures may, ere long, have to be taken to curtail certain electrical usage in order that such hydro-electrical energy as is available may be applied to the best and most efficient uses.

The Hydro-Electric Power Commission has been engaged upon studies of how best to solve this problem of a prospective power shortage. You, gentlemen, who are interested in the furthering of publicly-owned utilities know that you cannot move very much in advance of public opinion. On all hands, however, with the strong demand for electrical energy on the part of the public, there is, now, a well-formed public opinion and hence there is practically no reason why projects for the supply of low-cost electrical energy could not, at this period, be carried forward to successful completion much more readily than could have been done ten, fifteen or twenty years ago.

An Electrical Power Shortage in Prospect.

A review of the circumstances which govern in the electrical light and power situation clearly shows, I believe, that there is not now in sight from the sources of power already developed, sufficient hydro-electrical energy to meet the demands of the early future. The circumstances which I have outlined as applicable to the Province of Ontario, so far as I can learn, differ but little from general conditions prevailing in many of the States to the south of us.

The interests of many of the States of the Union are common to those in this Province. With this unity of general interests, there should be found, and as soon as possible, some plan upon which all interested parties can agree, making for the development of the St. Lawrence and the Niagara rivers in the general interests of navigation and of power. If effort is to be made along such lines it should be made by those who are intelligently informed respecting the various interests and issues involved. There is a good deal for some persons to learn upon this subject. The development of the St. Lawrence river is by no means a new project,—a great deal of literature exists discussing many phases of this great problem. Personally, I believe that agreement on the part of the federal and other governments involved upon some unified general plan for the development of the St. Lawrence river could be arrived at in such a manner as would permit this work to be initiated and, as circumstances warrant, carried forward to completion. The development of the St. Law-

rence would constitute a source of hydro-electrical energy which could be employed as a sound basis upon which publicly-owned, controlled and operated hydro-electric utilities in the United States and in Canada could satisfactorily be established.

St. Lawrence Power is Low-cost Power.

The quantity of St. Lawrence power which can be produced is large. It is ample to serve as a sound basis upon which many of you could materialize your doctrines of public-ownership. Had the Commission had its way, St. Lawrence power would now be under development and would be aiding to build up industries in Ontario.

At the end of fifteen years of its work, the Commission and the Hydro municipalities find themselves administering assets aggregating $250,000,000. Yearly the Hydro municipalities are expending additional millions to increase and improve their municipally-owned undertaking. The basis of the whole project is power and light for the people at cost.

The Public Ownership Conference

FROM September 10th. to 13th, 1923, there was held at Toronto, a Public Ownership Conference, under the auspices of the Public Ownership League of America, the Hydro-Electric Power Commission of Ontario and the City of Toronto.

The general object of the Conference was to bring together the leaders of thought and action and the representatives of municipally and publicly owned utilities in the United States and Canada for the consideration and study of the problems involved; to get the ideas of the most careful and competent utility experts in America; to hear of the methods and plans of those who have made a success of public ownership; and to consider ways and means of conserving and advancing the interests involved in our great utilities and natural resources, especially with reference to the tremendous opportunities now confronting our civilization in the matter of hydro-electric and super-power development.

The proceedings opened with an address of welcome with remarks on Public Ownership in Toronto by His Worship, C. A. Maguire, Mayor of Toronto. This was responded to by Mr. Willis J. Spaulding, Commissioner of Public Works, Springfield, Illinois, and President of the Public Ownership League of America, who acted as President of the Conference.

From the great number of subjects discussed at the conference and the great distances some of the speakers came to address it we are given some idea of the work of the conference and the vast territory

from which the Public Ownership League draws its membership. Some of the speakers with the subjects of their addresses are given in the following:

Prof. Edward W. Bemis, Chicago—"Public Utility Appraisals."

Mr. Leo Kenneth Mayer, Director American City Government League, New York—"What Municipal Transportation Systems in American Cities Have Accomplished."

Mr. J. E. Lowry, Commissioner Manitoba Government Telephones—"Public Ownership of Telephones in Manitoba."

Hon. George W. Joseph, Portland—"Public Ownership Possibilities in Oregon."

Sir Adam Beck, Chairman, Hydro-Electric Power Commission of Ontario, Toronto—"The Hydro-Electric Power Commission of Ontario."

Mr. W. H. Wood, Manager Brantford Chamber of Commerce—"Public Investment in Public Utilities."

Mr. D. E. Bivins, City Manager Leesburg and representing Florida League of Municipalities—"Public Ownership of Utilities in Towns and Small Cities of Florida."

Hon. A. Emil Davies, London, Chairman of Nationalization Society of England—"Progress of Public Ownership in Europe and Especially in the British Possessions."

Mr. Oliver T. Erickson, Member City Council, Seattle—"The Public Ownership Movement in Seattle and Washington."

Mr. George Wright, Commissioner Toronto Transportation Commission—"The Municipal Street Car System of Toronto."

Hon. William J. Hosey, Mayor of Fort Wayne, Ind.—"Our $1,500,000 Municipal Light and Power Plant."

Mr. Ralph L. Criswell, Representing City Council of Los Angeles—"The Aqueduct and Power Bureaus, Boulder Canon Project and Harbor Development of Los Angeles."

Mr. F. J. Malley, Business Manager, Winnipeg—"The Winnipeg Hydro Electric System."

Mr. Carl D. Thompson, Secretary Public Ownership League of America—"The Work of the Public Ownership League and Progress of Public Ownership in United States and Canada during the last Two Years."

The Public Ownership League is a non-partisan organization and co-ordination of forces working in the interests of the wealth we own in common—schools, roads and bridges, the postal service, libraries, parks and forests; water works, electric light and power plants and similar public utilities.

Wherever cities, states or the nation already own such enterprises the League endeavors to promote their successful administration and operation. And where experience and reason have led the people to undertake the public ownership of one or the other of their basic public utilities the League is ready to help.

Its membership is open to all municipalities, state legislatures, Governors, Mayors, Commissions, Commissioners and City Managers.

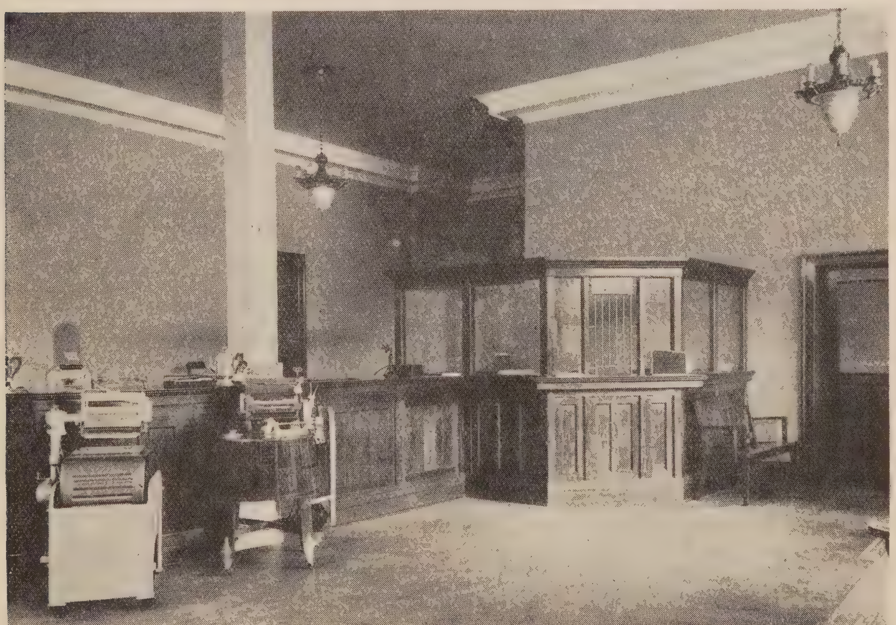
All progressive people, civic, commercial, labor and farm organizations and popular groups of all kinds that are interested in a conservative and constructive solution of our great public utility problems are invited and urged to attend, send representatives and take part in its conferences.

Niagara Falls New Station and Office Building

DURING the month of March the Hydro-Electric Commission of Niagara Falls moved into their new building at the corner of Victoria Avenue and South Street.

The building is fireproof and modern in every respect, being constructed throughout of reinforced concrete, and faced with No. 1 Milton Rug Buff Brick, and Bedford Gray Stone, the ground line dimensions being 108 by 56 feet; two stories high, with a full-story basement underneath. The architect of the building was C. M. Borter, of Niagara Falls, the building contractors being The Robertson Construction and Engineering Co., of Niagara Falls.

The Station end of the building is approximately 67 ft. by 44 ft., a fire



Section of Show Room

Manager's Office

wall extending up from the ground to the roof between the office and station. The engineering and installation of all the electrical equipment was handled by the Hydro-Electric Power Commission of Ontario.

The 2-12,000 volt incoming lines enter the building through roof bushings, each line being equipped with choke-coils, General Electric Co. Oxide Film lightning arresters, disconnects and Westinghouse G. A. 3 oil circuit breakers and overload relays. From the oil circuit breakers each line feeds a 12,000 volt bus through disconnects, and from this bus the present 3 banks of step-down transformers are served. All the 12,000 volt equipment is located on the top floor, with provision for another line and future transformer breakers.

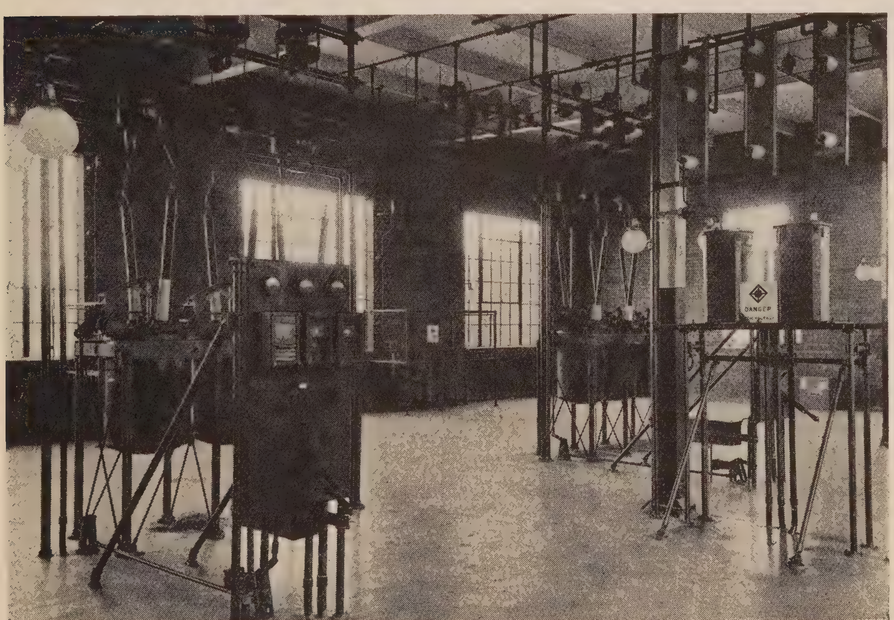
The step-down transformers are located in the transformer room on the south side of the control-room on the main floor. This room is equipped with a track and a 25 ton transformer truck, also a 15 ton Morris chain hoist. The present transformer installation consists of 2-1500 kv-a.,13200/2300 volt, 25-cycle O.I.W.C. Crocker-Wheeler three phase transformers, and one bank of 3-884 kv-a. 12000/2200 volt 25-cycle O.I.W.C. single phase Crocker-Wheeler transformers. The oil connections of all the transformers are connected through valves to a common header and a 2000 gallon oil tank in the basement. This oil

tank is also equipped with a rotary hand pump, so that oil can be pumped to either of the two floors. The water piping is also connected to a common header, and is so arranged that water can be used from either the city mains or from their own cooling pond, located at the rear of the lot, by means of a Rees Roturbo pump direct connected to a Westinghouse 7½ h.p. 3 phase motor.

The control-room is located on the main floor, and is approximately 27 ft. by 67 ft., and is the standard Hydro construction for 2300 volt, remote control, with both main and emergency 2300 volt buses. All breakers on outgoing three phase circuits are the General Electric Co. K32 Type, 600 ampere, 15000 volt. At the present time there are 3-three phase power circuits, and 4-three phase commercial lighting circuits, and 5 series street lighting circuits feeding out of the station, with provision for three more power and two more commercial lighting circuits.

All 2300 volt feeders leave the station underground, and come up to the overhead lines at four different points, thus eliminating congestion.

Each feeder is protected with overload relays, and the power and lighting feeders each have their own graphic recording watt-meter, these together with the kilowatt hour meters on the station service and the street lighting feeder, make it very convenient for analyzing the load conditions.



High Tension Switch Room

Control Room

The main offices and show-room are located on the main floor, the entrance being at the corner of Victoria Avenue and South Street, thus giving a large window on each street for display purposes. Each of these windows is equipped with two-75 ampere 110/220 volt polarity flush receptacles for the demonstration of ranges, etc.

The offices and show-room are floored with Terramo, and the vestibule with 1in. hexagon tile. The counter and cashier's cage are made of No. 1 red oak, finished dull.

On the second floor directly over the main offices, are the board-room, meter-room, record and draughting rooms and ladies' and gentlemen's washrooms. All departments in the building are equipped with an inter-communicating telephone system. The lighting fixtures throughout the offices are semi-indirect, and were supplied by the Tallman Brass and Metal Co. of Hamilton.

All things considered the new Hydro Building is one which the citizens of Niagara Falls can point to with pride, and is not only a credit to the Commission, but individually to every one who worked upon it, and to all the firms whose products are used in the construction and equipment.

The members of the Hydro-Electric Commission of Niagara Falls for the present year are Messrs. R. J. Unsworth, Chairman; A. Zimmerman and C. R. Newman, Mayor; the chief executive officials are Messrs. J. E. Teckoe, Manager, and J. W. Bayliss, Secretary-treasurer.

Some Notes on the History of the Hydro Lamp

OWING to the attacks that are occasionally made upon our 1500 hour Hydro lamp and the resulting necessity of justifying its existence, it seems desirable at this time to review the lamp activities of the Commission and to trace the development of the Hydro lamp outlining the reasons for adopting efficiencies to produce a normal life of 1500 hours.

During the year 1912 when it was proposed to handle lamps in large quantities for resale to the Commission's Municipalities an extended series of tests was conducted on all the available makes of lamps both of domestic and foreign manufacture and from the results a selection was made and contracts were placed with the Phillips Glow Lamp Work, Holland. During the winter of 1912 and 1913 lamp shipments began to reach the Commission's stores for distribution.

At the time of the first contract the efficiencies were the same as were employed in America to produce 1000 hours. About one year after this, lamp manufacture was improved and the efficiencies in America were increased so as keep the life at 1000 hours. The Hydro lamps were not increased in efficiency and it was found that the life went up to 1500 hours and the average life was soon well above 1500 hours.

This longer life gave such universal satisfaction among the users that it became the standard life of Hydro lamps.

As the war progressed the conditions caused by it made the maintenance of standard quality in general almost an impossibility and with the added difficulty of importation due to high rates it became necessary for the Commission to secure lamps from any possible source to satisfy the demand.

Soon after the cessation of war when conditions were becoming normal the lamp question was reopened and the Commission was requested to re-establish the Hydro lamp on its pre-war basis. At this time there was a general feeling of dissatisfaction regarding the qualities of the lamps then on the market. The question of whether the lamps were to be rated for 1000 or 1500 hours life was very carefully considered. Technically this is a matter of adjusting the initial efficiencies.

Since a change of initial efficiency involves so many inter-related factors the problem of choosing the best efficiency is rather complicated. Stated briefly it is influenced by the relative costs of lamps and power. A high efficiency produces shorter life and greater light-output for a given watts rating than a low effi-

ciency. Consequently where power costs are low as on the Commission's systems it may be economical to sacrifice some of the efficiency of light production in order to secure long life and thus reduce the lamp renewal costs. On the other hand where power costs are high it is important to secure as much light as possible for the power consumed, within reasonable limits. The essential factors to be considered in determining the cost of producing light, that is the cost per candle-power-hour or the cost per lumen-hour, are the lamp cost, the rate per kw.-h., the lamp life, the average efficiency during life and the average c.p. or lumens during life. Information was obtained upon the cost of operating lamps over a wide range of initial efficiencies and rates for power.

Since over such an extended system as served by the Commission a difference in rates is to be expected and no one lamp design can be expected to prove the most economical in all situations, the problem becomes one of selecting the best compromise. From a careful consideration of all phases of the situation the Commission's engineers finally decided upon a rated life of 1500 hours for multiple lamps as best suited to the requirements of the Hydro Systems.

It is well known among those acquainted with the lamp industry that lamps of the lowest quality can be made to burn as long as desired provided the initial efficiency is sufficiently low. The real test of quality is long life at high efficiency. The market is flooded with lamps for which claims of long life are made. Many tests have been made at the laboratory that show these lamps very low in initial efficiency and when the results are corrected to Hydro efficiencies the life tests results in lives very much lower than required by Hydro specifications.

The value of maintaining an inspection and testing service in respect to incandescent lamps is indicated by the large number of users of large quantities of lamps in America that have all their lamp purchases subject to inspection and test. These include government, industrial, railroad and public service agencies.

It has been found economical to spend money for this testing service when fairly large quantities are used. To the great majority of lamp users, however, the cost of testing would outweigh its value and as a consequence they must take such lamps as they can secure, whether or not they are fully up to their standards.

The Commission through its lamp purchasing policy is very favorably equipped for rendering this valuable service to all its clients whether the purchasers are large or small. They are thus assured of getting lamps of the best quality.

An inspector stationed at the factory has direct observation of all lamps manufactured for the Commission and makes systematic tests of each batch of lamps to determine whether or not they are satisfactor-

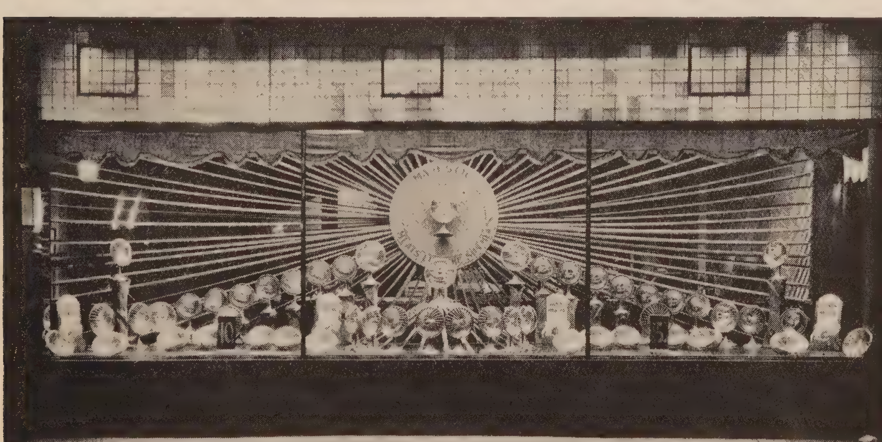
ily rated and conform to the requirements of the specifications in other respects. Samples of each batch that proves satisfactory at the factory are sent to the laboratory for the final and most important test, the life test.

Finally, confidence in the quality of a lamp is not inspired so much by the results of a few tests made occasionally but by the factories' ability to consistently turn a product of uniformly high quality. By the method of close inspection of the lamps at all stages of manufacture by our resident inspector and the continuous flow of life tests and by the favorable reports from the final lamp users we feel justified in believing that the Hydro lamp is of the highest quality.

Why Hydro Utilities Should Advertise

IN a great many Hydro utility commissions the underlying reason why the executives have not been "sold" on the idea of the value of advertising is because their training, experience and habitual viewpoint have not brought advertising clearly above their horizon. If they have glimpsed its meaning at all, it has generally been that it deals with intangibles to a greater or less degree—and intangibles are something that technical engineers, lawyers and unimaginative operatives and managers have had little sympathy with or understanding of.

But once these executives have been "shown" what advertising has done and can do, when given an honest and thorough test, a great majority of them give it the recog-



Effective Window Display, Windsor Hydro Shop

nition its importance deserves.

Hydro utilities should advertise because:

1. We have a two-hundred million dollar investment to protect.

2. We do $15,000,000 worth of business a year, and because intelligent advertising will stimulate it to greater growth.

3. We are far in the rear of every other modern business in advertising.

4. We need the greater good-will of our 380,000 customers.

5. Our business comes into more intimate daily contact with more people than any other line of business in the world.

6. Our business, which is so essential to the comfort and well-being of the people is highly technical, and the public does not understand it.

7. Our problems are the problems of the people, and we need their sympathetic understanding and support.

8. The people will be fair when they do understand all the facts, and systematic advertising is the most effective way to tell our story and give the people the facts.

9. Our exclusive business is salesmanship in its broadest application, and every form of salesmanship needs the fifty-fifty push and punch of advertising.

10. The selling of public service—essential and indispensable public service, if you please—is known, by experience and test, to respond as rapidly and in as great a measure to judicious advertising as the selling of any legitimate merchandisable commodity.

11. Many of our companies sell securities just exactly as investment houses do, and where would investment houses be if they didn't advertise.

12. Many of our companies sell merchandise exactly as department stores and specialty shops do—institutions whose advertising appropriations average from 2 to 7 or more per cent. of their gross each year.

13. The demand for any worthy product—service, security or commodity—can be created and stimulated by means of advertising.

14. The greater the demand for any product, the less will be the ratio of production cost, with proportionately greater economy of operation.

15. It is the specific function of advertising to create consumer demand and consumer preference.

16. Truthful, sincere, interesting and believable advertising is a recognized asset in modern business.

17. Advertising will bring the full benefits of the merit of our product.

18. Advertising is the most inexpensive motive power that our industry or any industry can buy to-day.

19. The great "buyers' strike" following the world war proved that more and better advertising meant more and better business and more and better good-will.

20. The place of advertising in the present economic system is thoroughly well-established.

21. Business exists, in the last

analysis, in the minds of its customers.

22. While you may supply the actual needs of the public without advertising, the actual needs are but a fraction of the demand that can be created, and advertising is a prime mover in creating this demand.

23. Public utility commissions in many places have recognized advertising as a legitimate operating expense, both in the creation of good will and in business building, thereby nullifying the somewhat widespread popular criticism that advertising by public utilities is a needless extravagance.

24. A public utility that advertises consistently finds it easier to finance its requirements than one which does not advertise. Bankers generally look upon a good advertiser as a good borrower, and prospective borrowers are frequently asked "What is your advertising appropriation?"

25. Experience shows that public utilities which have adopted definite advertising programmes on a budget basis have never abandoned this policy, but, on the other hand, have shown a tendency to expand their advertising appropriations year by year.

26. Advertising, properly used, will increase the turnover for utilities just as it does in other lines of business.

This list of "becauses" is by no means complete. It could probably be elaborated to twice the number given, and even among some of those set down there is some overlapping, yet the main thought is to show public utility companies that they have an abundant reason for giving advertising a fair trial and little, if any, reason for not doing so.

When it is considered that a mighty industry with a combined capitalization of more than $200,000,000, with a yearly gross business exceeding $15,000,000, deals in intimate daily contract relations with an aggregate of more than 300,000 customers, the importance of advertising to this industry need not be further emphasized.

Based on a 2 per cent. minimum of annual gross business Hydro Utilities should be spending around $300,000 a year for advertising. Instead of the 2 per cent. minimum, the utilities are trailing along with an average of less than one-fifth of one per cent. Five years ago, the amount was probably less than half what it is now.

Billing for Service When Unable to Read Meter

BY W. R. CATTON

Manager, Brantford Hydro-Electric System

In a provincial wide organization such as the Hydro-Electric Power Commission of Ontario with its hundreds of local systems, there is every reason why only the best and most economical methods of management should be in general use. Ever so often, at some point in the system, somebody will invent some new apparatus or adopt some new phase of management which will help to reduce expenses and increase efficiency and

which might also prove of equal benefit at other points on the line.

In Brantford, one meter reader covers the 5000 residences once every two months. In a large number of instances, particularly in summer time he has been unable to gain access to premises owing to the absence of the tenants. This meant another and sometimes two visits to obtain these readings. It also meant delay in billing and extra expense for extra help.

In dealing with the situation the management discussed first the postcard system with the dial illustration but chose instead the following notice:

> The Kilowatt Hours shown on this account were estimated from past readings, because our meter reader did not get in to read your meter. If you have been over-charged, the correction will be accurately made at next reading. This method saves a large 4 months' account.
>
> BRANTFORD HYDRO-ELECTRIC SYSTEM.

After trying out for several months this method of billing where no meter reading had been secured the Brantford officials are satisfied that it has proved very satisfactory in every respect. Customers have fallen in line with the idea and a great deal of delay and expense has been avoided.

Association of Municipal Electrical Utilities

Minutes of meeting of Executive Committee held on October 5th, 1923.

The meeting was called to order at the office of the Hydro Electric Power Commission at 2 p.m., the Vice-President, Mr. J. E. B. Phelps acting as Chairman.

Other members of the Executive Committee present were: M. J. McHenry, J. J. Heeg, W. E. Reesor, J. R. McLinden, V. S. McIntyre, G. J. Mickler and S. R. A. Clement.

This meeting was for the purpose of arranging for the winter convention of the Association, to be held in Toronto, and also to transact any other business waiting for its consideration.

A letter from Mr. P. B. Yates, Manager, The Public Utilities Commission, St. Catharines, in reference to the handicaps that the Province of Ontario labors under in securing new industries in competition with the Province of Quebec was considered.

It was moved by Mr. V. S. McIntyre and seconded by Mr. J. J. Heeg:

That Mr. Yates' letter be referred to the Ontario Municipal Electrical Association for consideration.—Carried.

Referring to a letter from Mr. Wills Maclachlan, suggesting that this Association consider the proposition of joining in with the Canadian Electric Railway Association and the Canadian Electrical Association in holding its summer convention at the same time and the same place as those Associations, and entering into joint sessions with them the following resolution was presented:

Moved by Mr. M. J. McHenry and seconded by Mr. J. R. McLinden.

That the matter of holding conventions concurrently with those of the Canadian Railway Association and the Canadian Electrical Association as outlined in Mr. Maclachlan's letter be brought before this Association at its January convention, with the recommendation that it would not be advisable to hold a joint convention with those Associations.—Carried.

A letter from Mr. S. A. Saylor was read. In this letter Mr. Saylor expressed his regrets at being unable to attend the meeting of the Executive and enclosed a report from the committee on Accident Prevention and Health Promotion, and also copy of a letter from Mr. M. M. Inglis, Manager, Public Utilities Commission, Port Arthur.

Mr. Inglis' letter referred to the provision of the Public Utilities Act that arrears for electric service shall become a lien on the property so supplied. He expressed the opinion that from the experience in Port Arthur, the provision should go further and stipulate just what type of lien the Utility has for arrears of service.

It was moved by Mr. J. J. Heeg and seconded by Mr. V. S. McIntyre:

That the Secretary write Mr. Inglis advising him to take the question up with his own solicitor to obtain an interpretation of the Public Utilities Act.—Carried.

The report of the Committee on Accident Prevention and Health Promotion, reiterated recommendations made by it at the beginning of the year as follows:

a. That a set of working rules in hand book form, 4½ in. x 7 in. be prepared by the H.E.P.C. Engineering Staff to be sold to the Utilities at cost (estimated approximately $4.00 each).

b. That the Association membership be circularized advocating the securing of the services of the local Medical Officer of Health in giving at stated periods short talks on health promotion.

c. That for the Winter Convention there be secured the services of some prominent local health officer to give a paper on Health Promotion to be followed by a practical demonstration of First Aid to the Injured, put on by some competent First Aid Team, preferably members of St. John's Ambulance Association.

Regarding the book of working rules, the Secretary reported that he was informed that these were being prepared and would probably be ready for distribution by the end of next winter. No action was taken on Section "b" of Mr. Saylor's report, while Section "c" was referred to the Papers Committee to be considered along with its report.

Plans for the Winter Convention of the Association were next considered.

It was moved by Mr. M. J. McHenry and seconded by Mr. J. J. Heeg:

That the next convention of the Association be held on January 24, 25 and 26, 1924.—Carried.

It was moved by Mr. W. E. Reesor and seconded by Mr. M. J. McHenry:

That the Secretary be instructed to investigate the accommodation at the Carls Rite Hotel, and if found not sufficient to arrange with the King Edward Hotel.—Carried.

It was moved by Mr. M. J. McHenry and seconded by Mr. W. E. Reesor:

That Mr. V. S. McIntyre arrange for a speaker for the convention dinner.—Carried.

After discussing various suggestions for papers to be presented at the convention, it was moved by Mr. M. J. McHenry and seconded by Mr. J. J. Heeg:

That the following papers be presented:

1. Electric Welding.
2. Voltage Regulation.
3. Electric Heating.

and that during the second day a round table conference of the Utility Appliance Salesmen be held, to be conducted by Mr. Mickler.—Carried.

Mr. McHenry was instructed to arrange for the papers.

Mr. J. J. Heeg reported on behalf of the Regulations and Standards Committee that the revision of the Commission's Rules and Regulations for Inside Electrical Installations was nearing completion and would be referred to the Committee at an early date.

The meeting then considered suggestions brought up by the Merchandising Committee, and it was moved by Mr. M. J. McHenry and seconded by Mr. V. S. McIntyre:

Resolved that the Hydro Electric Power Commission of Ontario is to be encouraged in the production of the Hydro Lamp, and that this executive go on record as recommending that the Hydro Shops push the sale of Hydro Lamps to the utmost, and that they co-operate with the Hydro Electric Power Commission in case of dissatisfaction so as to eliminate troubles and defects with the ultimate object of keeping up the standard of the lamps to that desired by all municipalities—a 1500 hour lamp.—Carried.

The meeting adjourned at 5 p.m.

A. M. E. U.

Winter Convention

At Toronto, January, 24th, 25th and 26th, 1924

Hamilton Transformer Station

IN 1921, the growing load conditions in the City of Hamilton indicated that the transformer capacity at our Dundas Transformer Station from which the City of Hamilton was supplied through four 13,200 volt overhead circuits, to their Dundurn Sub-Station located in the west section of the city, would soon be entirely inadequate to handle this load. After a careful study of the local conditions, it was decided to build a new 110,000 volt station at Hamilton in preference to increasing the transformer capacity of Dundas Transformer Station.

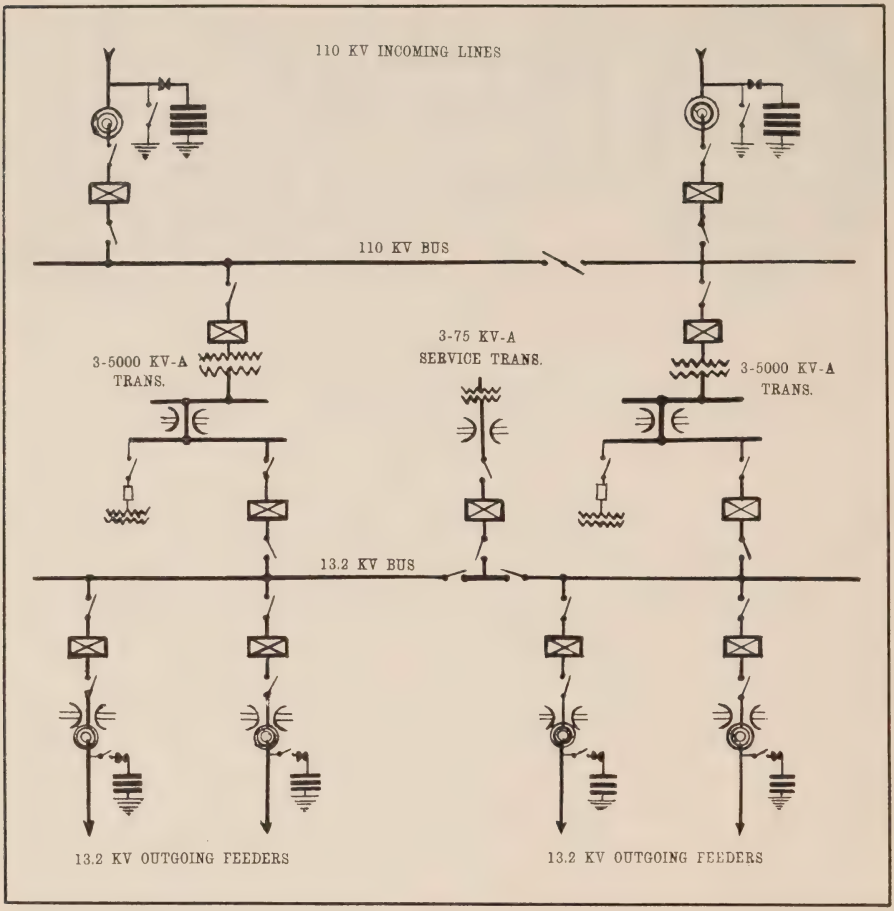
This being the first 110,000 volt Transformer Station required by the Commission since the successful operation of outdoor high voltage switching equipment on systems subjected to similar severe climatic conditions encountered on our systems, the relative merits of the installation of outdoor and indoor equipment were carefully investigated both from the economic and operating standpoints with the result that it was decided to install 110,000 volt switching equipment and power transformers outdoors and the 13,200 volt switching equipment indoors, the building required being also utilized to house the switchboard and auxiliary equipment.

Location.

This transformer station is located on the south side of the Beach Road bordering on the easterly limits of the city of Hamilton. Its location was determined partly by the gradual shifting of the load centre to the north-eastern part of the city and partly by the fact that power was to be supplied to same from the two new 110,000 volt circuits from Queenston Station passing across Burlington Beach.

Scope.

In designing the station, provision was made for three 110,000 volt line circuits, five banks of three 5,000 kv-a. single phase transformers, and fifteen outgoing 13,200 volt feeders with all necessary station service equipment. Space has been provided for a duplicate set of 13,200 volt bus bars and a duplicate set of outgoing feeder equip-

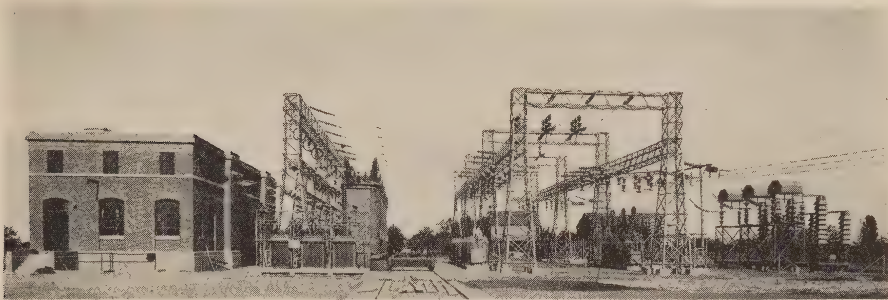


Wiring Diagram

ment for each feeder. The first installation consists of two incoming 110,000 volt circuits, two banks of 5,000 kv-a. transformers, one 13,200 volt bus, and four outgoing 13,200 volt feeders as shown on the wiring diagram with the station service equipment.

High Voltage Lines

The two incoming 110,000 volt lines are each equipped with a three pole automatic oil circuit breaker and disconnecting switches and a three phase oxide film lightning arrester. The oil breakers are of very rugged design with ample rupturing capacity for cutting these lines out of service under short circuit or grounding conditions. The lines are protected with reverse power and low current ground relays operated from bushing type current transformers mounted in the oil breakers which cut out of service only the line which is in trouble. The bus



General View from the South

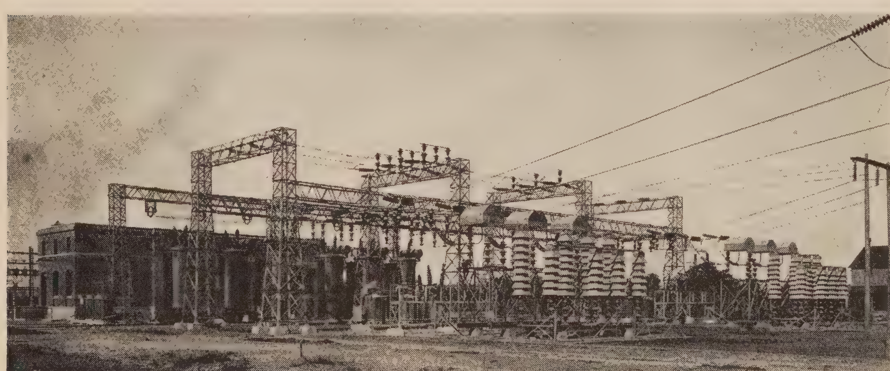
disconnecting switches are of swivel type and mounted on the top of the steel structure. They are arranged for gang operation and controlled by lever from the ground.

Transformers.

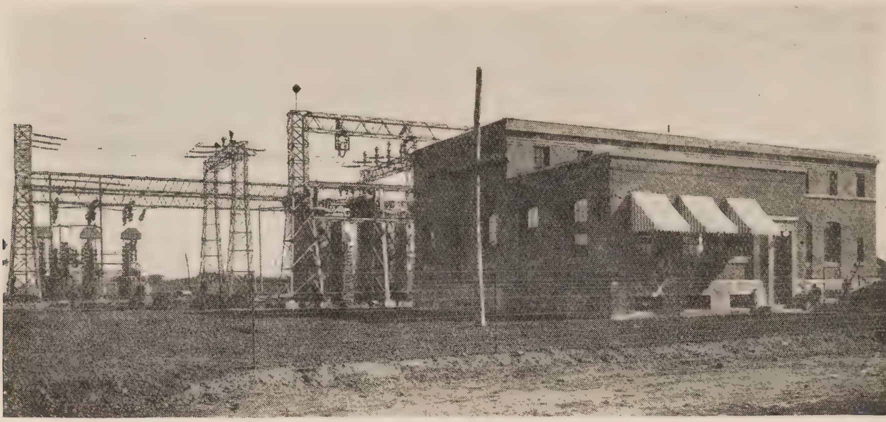
The two present banks of transformers consist of 5,000 kv-a. 25 cycle, single phase, 63500/13200 volts, oil insulated self cooled units with self-draining water coils. These transformers are protected on both high and low tension sides with automatic oil circuit breakers of proper rupturing capacity. The relay protection on these transformer banks consists of both overload and differential protection, the inverse definite time overload relays cutting only the high tension breaker out of service and the instantaneous differential relays cutting both high and low tension oil breakers out of service. H.E.P.C. 66,000 volt air insulated outdoor type current transformers mounted on the steel structure above the power transformers are used for operating both the overload and differential relays.

Low Voltage Equipment.

The four outgoing 13,200 volt feeders are equipped with similar breakers to the power transformers but of lower continuous current carrying capacity. These breakers are at present protected by inverse definite time overload relays but provision has



General View from the South East



General View from the North West, showing Control Room Section of Building

been made for installing balance type relays on same later. The feeders are now taken out of the station underground to a pole structure on the west side of the station and connected to the overhead lines on this structure, each line being protected with choke coils and a three phase oxide film arrester. The 13,200 volt service feeder is also taken out underground to a bank of three 75 kv-a. 13,200/575 volt outdoor transformers supplying power for station lighting and for oil and water pumps and an air compressor and battery charging set.

Building

The present building has sufficient space to house the 13,200 volt busses and switching equipment for two transformer banks, six outgoing and one service feeder, and one bus-tie oil breaker. It consists of two storeys and basement and is designed so that it can be extended to the north as additional transformer banks are installed. The building is of brick and steel construction with concrete foundations, floors and roof.

The second floor, with very low ceiling, is used as a 13,200 volt bus room, the busses running horizontally on insulators mounted directly on the floor. The bus disconnecting switches are of inverted type and the floor is slotted to allow the operation of the switches from the main floor below. The 13,200 volt switch structures and the control room are located on the main floor. The 13,200 volt equipment on the main floor is entirely enclosed, doors being placed on the switch structures and a false ceiling being erected under the leads running from the switch structures to the busses on the floor above. The doors on the switch structures are arranged to open in groups of three so that no mistake can be made in opening the wrong compartment.

The control room contains the two main switchboards, control and relay, and the 550 volt service board. The indicating meters and the controllers for the oil circuit breakers are mounted on the control switchboard

and the relays and the recording meters on the relay switchboard. The 550 volt service board consists of two 1/4 in. sheet iron panels on which are mounted the 550 volt fused service switches in metal safety boxes.

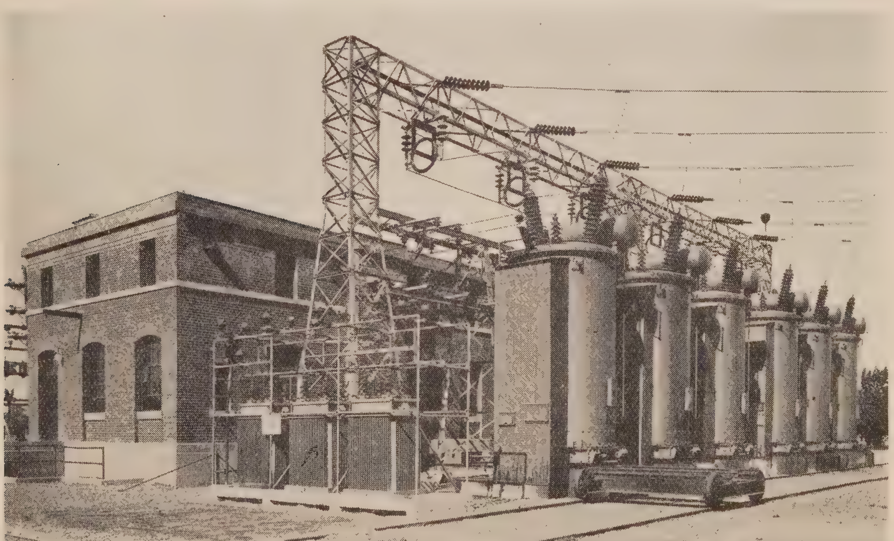
OIL CIRCUIT BREAKER CONTROL.

The oil breakers are all electrically operated with 110 volt direct current closing and tripping coils and each breaker is equipped with its own magnet switch. Two trip-free relays are also installed, one for the 110,000 volt oil breakers and the other for the 13,200 volt breakers, so that when an oil breaker is automatically cut out of service, it cannot be closed until the operator operates the re-set switch closing the trip free relay contacts. This relay therefore prevents the "pumping" action of the oil breaker by the controller being held in the closed position during trouble.

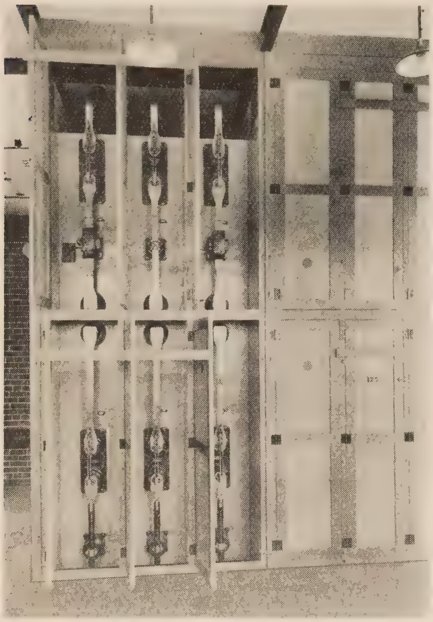
Power supply (110 volt direct current) for operating the oil breakers is obtained from a 60 cell 120 ampere hour battery erected in a special room in the basement. A motor generator set, and complete charging equipment is provided for charging the battery.

WATER COOLING AND OIL HANDLING EQUIPMENT.

The transformers are cooled by a water circulating system consisting of a cooling pond, two electrically-driven water-pumps, and the necessary piping for same. The cooling pond and pump house are located in a depression about 100 yards from the transformers and the water is pumped to a header located on the east wall of the basement from where it is distributed to the transformers whence it drains by gravity to the cooling pond. Valves are placed in the transformer feed



5000 kv-a. Transformer and Service Transformer Installation



13200 volt Switch Structure, showing 13200 volt Disconnecting Switch and Current Transformer Installations

pipes in the basement so that the water can be cut off any transformer and drain valves are also included for draining the feed pipes when not in service to prevent freezing. The piping above ground at the transformers is well lagged and encased in housings to prevent freezing in the winter season. Water is obtained from the Hamilton city service but no direct connection is made between the station circulating and city system, the pond being filled by running the city water into the drain pipe from the building.

The oil system consists of two storage tanks (respectively for transformer and switch oil), one electrically driven pump, one electrically driven oil filter press, and necessary piping connections to the power transformers and the 110,000 volt oil breakers. This equipment is installed in the basement and the arrangement of valves gives a very flexible operation of same. A steel hopper with pipe connection to the oil storage tanks in the basement is located between two of the power transformers at the track runway for facilitating the handling of new oil. An air system consisting of electrically-driven compressor and storage tank is also located in the basement with piping to the power transformers for assisting in lowering and raising the oil in same and outlets in various parts of the station for cleaning purposes. The sanitary system consists of H.E.P.C. standard septic tank and filter bed.

Design and Construction.

The station was completely designed and installed by the Commission's Electrical Engineering and Construction Departments with the exception of the erection of the station building and the power transformers.

The steel structure for the 110,000 volt equipment was fabricated by the Canadian Bridge Company and the building was erected by contract by Pigott and Healey of Hamilton, Ontario. The main transformers were erected by the makers.

The Canadian Westinghouse Company supplied the 110,000 volt oil switches and the blades for the disconnecting switches, the six 5,000 kv-a. transformers, the 13,200 volt oil switches and all the relays. The Ohio Brass Company supplied the insulators for the 110,000 volt disconnecting switches. The Canadian General Elec-

tric Company supplied the 110,000 and 13,200 volt oxide film lightning arresters. The Ferranti Meter and Transformer Manufacturing Company supplied the 13,200 volt indoor disconnecting switches and bus insulators. The Exide Batteries Limited of Canada supplied the storage battery and the Canadian Crocker Wheeler Company the battery charging motor-generator set. Weston Electric Company indicating meters were used throughout on the switchboard which was made up in the Commission's machine shop from slate supplied by Davis Slate and Manufacturing Company.

The oil pump was supplied by Darling Brothers, the oil storage tanks by Toronto Iron Works, and the oil filter press by W. R. Perrins Limited, all of Toronto. The two electrically driven water pumps were furnished by the Northern Foundry Machine Company of Sault St. Marie, Ontario, and the air compressor by the Storey Pump and Equipment Company, Toronto. The transformer truck was supplied by the Herbert Morris Crane and Hoist Company of Niagara Falls, Ontario.

Actual construction work commenced on this station in August 1922 and the station was placed in temporary service with one bank of power transformers and temporary 13,200 volt outdoor switching equipment on October 8th, 1922. The second bank of power transformers was placed in service in December 1922 and the permanent 13,200 volt switching equipment in June 1923.

"I Serve"

"I serve," said Doctor Sawbones, "I'm ready day and night to mend your bones and salve your wounds and help your failing sight. I'm there and over, always; I'm Johnny-on-the-Spot; you bust your slats, then call for me, I fix 'em on the dot." That day young Billy Flashpast got out his racing car; said he, "I'll show these villagers how slow they really are." He hit it up the Average so fast you couldn't see; he ended down on Curtis street just half-way up a tree. They phoned for old "Doc" Sawbones to sew his busted skin, to splice his slats and mend his neck, but old "Doc" wasn't in. They tried the club, the links, the park; they couldn't find him there; he was off on his "vacation" filling up on mountain air.

"I serve," said the Electric Spark—"I'm ready day and night, I push and pull for every need and fill the world with Light; at every moment of the year I'm at your instant call, just snap my switch and watch me leap to serve you one and all." Ten million people heard the Spark and vowed to test his claim; they said, "You talk like 'Sawbones'; your bragging sounds quite lame; we'll bet that when we need you most, like 'Sawbones' you'll be gone; you wax a thread with oily talk to string us suckers on." They sat up full

ten thousand nights and worked with right good will; they pressed the buttons in the home, three switches in the mill and every time they called the Spark he answered in a flash and turned the wheels or flooded Light with brilliancy and dash. The doubters faced his wondrous work then solemnly decreed, that "Spark" was all he claimed to be—he filled the world's great need; that henceforth as a just reward for service, strength and nerve this Motto should be his alone—the simple words—"I Serve."

—The Synchronizer.

The Ontario Hydro Tennis Finals

The Ontario Hydro Tennis Finals were played on Saturday afternoon, October 6th.

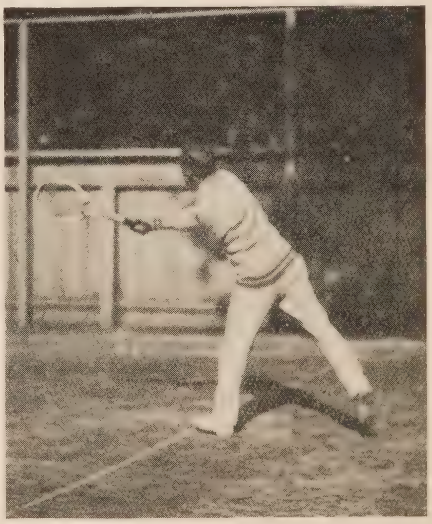
The feature of the afternoon was the men's singles when Roe and Vogan battled for the Silver Cup donated by Sir Adam Beck. Vogan has a natural backhand which enables him to return the ball with speed and placement down the side lines and to the corners in a manner most bewildering to his opponent. Roe's strong point is the overhead volley, his smashes from the centre of the court being most cleverly executed. Vogan's steadiness, however, told in the long run and although nearly every game went to deuce, he finally won out, the score being 6—4, 7—5, 7—5.

Another good game was the Ladies' Singles in which Miss Brown opposed Miss Burton. Previous to this match Miss Brown had played three strenuous sets in the mixed doubles. Miss Brown played well, her returns from the base line being extremely good, but Miss Burton's strong service and chop stroke enabled her to win, the score being 6—4, 6—4.

In the ladies' doubles Miss Williamson and Miss Coughlin defeated Miss Mabel Evans and Miss Margaret Evans in the straight sets—6—3, 6—2, while Black and Vogan easily disposed of Lumgair and Pyburn in the men's doubles by the score of 6—2, 6—3.

In the mixed doubles Miss Grayson and Lumgair defeated Miss Brown and Moffat after three hard fought sets 4—6, 6—3, 8—6.

The prizes were presented by Mr. W. W. Pope. The following gentlemen acted as referees—Messrs. Lang, Maddock, Merrill and Simpson.



Mr. E. B. Merrill in action

Hydro News Items

Central Ontario System

Temporary service is being supplied to Warkworth, from Dam No. 8 construction station over the private telephone circuit, pending the completion of the Transformer Station.

* * *

Contracts for rural service have been signed by petitioners in the Township of Darlington. A rural power district has been approved and construction will be started this season.

* * *

A rural power district has been defined and contracts are being signed for rural service in the Township of Murray.

* * *

Estimates are being prepared for the change of the local distribution system in Belleville from 2400 volts delta to 4160 volts "Y".

* * *

The lines in the business district of Bowmanville are being reconstructed to provide for increased load.

* * *

Satisfactory progress is being made on the new municipal sub-station at Peterboro. The transformers are on the ground and the building will be completed by about November 1st.

* * *

Niagara System

Work has recently been commenced in connection with the installation of twelve miles of underground cable in the Lynden Rural Power District. The greater part of the work in connection with laying this cable is being taken care of by the farmers to be served from this line.

* * *

The Commission have over one-hundred miles of cable now in operation in rural power districts, and it is giving excellent service, and the operators handle it quite as easily as overhead lines.

* * *

The fifth generator at Queenston Plant was put into operation several weeks ago, and it is expected that the sixth unit will be available during the latter part of December.

* * *

The new 110,000 volt line from Queenston to Allanburg was put into operation recently. This gives a second double circuit line from Queenston Plant to tie in with the Niagara System.

* * *

Work will shortly be commenced in connection with the construction of a 4000 volt line from Hagersville to Jarvis, and a distribution system in the Municipality of Jarvis.

* * *

The Niagara Falls Hydro-Electric System is arranging for an additional debenture issue of $50,000 to take care of extensions to the System. Since hydro power was introduced in 1916, the number of customers has been doubled, the power load has been tripled, and the average kilowatt hour cost to consumers has been reduced to less than one-half previous rates.

* * *

Power was first supplied to the Village of Stouffville on September 28th.

* * *

Ottawa System

The Ottawa and Hull Power Company from which the Commission secures its supply for the City of Ottawa, has been purchased by Montreal capital, and additional generating capacity will be developed at once. The Company proposes to develop about sixty miles above Ottawa on the Ottawa River.

* * *

Rideau System

The recent fire in Almonte caused considerable damage, but Mr. Black the Secretary of the Local Commission, informs us that owing to the splendid efforts of the fire fighters, no serious damage was done to the electric light plants. In the last issue of the Bulletin we published the report that these plants had been damaged and we are happy to learn that this is not the case.

* * *

The recent rate reductions in Kemptville and Lanark, have been much appreciated, and in Kemptville the Commission has received several inquiries for additional power.

* * *

Surveys and investigations have been made by the Commission re. an additional development on the Mississippi River for the Rideau System.

* * *

St. Lawrence System

The Municipality of Finch was recently furnished with revised estimates on supplying Municipality with power, and the matter has been taken up by the Council, in order to determine the feasibility of economically serving the Municipality.

* * *

Kenyon Township recently signed a contract with the Commission for supply of power, permitting the Commission to serve customers in the Apple Hill Rural Power District. In this district a start has been made to serve rural customers and it is expected that additional services will be made shortly.

* * *

The Municipality of Alexandria proposes to serve a Wood-working Industry which is establishing a plant three miles below the Municipality at C.P.R. station at Green Valley. Rates and details in connection with the manner of supplying the customer, have been furnished and contract drafted for the signatures of the parties concerned. The load will probably exceed 50 h.p. and the contract is for a term of ten years.

* * *

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in September 1923.

Appliances

THE MIS-CAN-ADA MFG. CO., LIMITED, 8-12 Chamberlain Avenue, Ottawa, Ont.

"Mis-Can-Ada" Vacuum Cleaner.

* * *

SAFETY ELECTRICAL APPLIANCES LIMITED, 294 Brunswick Avenue, Toronto.

"Defender" Flat Iron.

* * *

THE CANADIAN ELECTRIC FLOOR WAXER AND POLISHER COMPANY, LIMITED, 22 Mark St. Toronto.

"The Sun" Floor Waxer and Polisher, Model K, Model D.

* * *

MR. C. E. ROGERS, 8731 Witt St., Detroit, Mich.

Ice Cream Brick Machine.

* * *

THE LANCASHIRE DYNAMO AND MOTOR CO. OF CANADA LIMITED, 45 Niagara St., Toronto.

15 kv—a. 550 volts, 25 and 60 cycle Electric Welding Machine.

* * *

HOOVER SUCTION SWEEPER CO. OF CANADA, Hamilton, Ont.

Vacuum Cleaner, "Model 541" replaces "Special Model 105."

* * *

TORONTO LOCK MANUFACTURING CO., Patterson Place, Toronto.

Electric Mantel Grate, Cat. Nos. 27 and 28.

* * *

*ELECTRAHOT APPLIANCES, INC., 301-307 Fifth Ave. South, Minneapolis, Minn.

"Electrahot" Percolator, 110-120 volts, 550 watts.

"Electrahot" Soldering Iron, 110-120 volts, 100 watts.

"Perfecurl" Curling Iron, 17 watts, 110 volts.

* * *

*BETTS & BETTS CORPORATION, 511 West 42nd St., New York, N.Y.

Air-cooled Transformers, 60 cycles primary 110 volts; secondary 9 volts, "Vim".

* * *

*MEADOWS MFG. CO., THE, Bloomington, Ill.

Washing Machines, Models Greyhound and Meadow Lark.

Fittings

THE FINDLAY ELECTRICAL PORCELAIN Co., Findlay, Ohio.

"F" Porcelain Bushings and Tubes, Knobs and single, two and three-wire Cleats.

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, 224 Wallace Ave., Toronto.

Medium Base Sockets, C.G.E. 174, C.G.E. 176, G.E. 593A, G.E. 595A.

Medium Base Receptacles, G.E. 773A, G.E. 610A, G.E. 613A, G.E. 615A, G.E. 616A and G.E. 617A.

* * *

*WHEELER REFLECTOR Co., 156 Pearl St., Boston, Mass.

Medium Base Receptacles, "W.R. Co." porcelain shell, Keyless, Cat. No. 1275.

* * *

Switches and Cutouts

*KIRKMAN ENGINEERING CORPORATION, 484 Broome St., New York, N.Y.

"K.E." O-600 amperes, 250 volts, O-600 amperes, 600 volts Cartridge Enclosed Fuses—Non-Renewable.

"K.E." O-30 amperes, 125 volts Plug Fuses.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

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NOVEMBER, 1923

A City of Sixty Lights

The Hydro Lamp, which is a sort of house organ for the Hydro Electric Power Commission of Ontario, in its September issue has an article entitled: *The City of One Hundred Thousand Lights.* The city referred to is the Canadian National Exhibition. The merry-go-round takes a thousand lights, the midway another thousand; 2,600 exhibitors require 20,000 lights; the streets take 1,500, the Dufferin entrance 7,600, the domes of the Government and Horticultural buildings 600 more, and the Slogan Tower calls for 2,200, while the big stage requires a like number. And so the tale of the lights is told.

Let's turn back the calendar of the years. On the writer's desk lies a copy of a queer newspaper of date—August 26, 1882—why that's forty-one years ago. The name of this paper is *Canada First.* The issue we have was printed with white ink on black paper, a stunt done out of honor to the Association for the Advancement of Science, which was in session in Montreal.

So much for that. Down in the corner there is tucked this item:—

> Toronto has made arrangements to have 60 Electric lights on their Exhibition Grounds, during the five evenings the Fair continues.

Placing *The Hydro Lamp* and *Canada First* side by side, one is forced to the conviction that Toronto's fall fair is moving ahead.

—The Welland Tribune and Telegraph.

How Ontario Does It

A New Kind of Business Partnership.

By Judson King, Director, National Popular Government League, Washington, D.C.

Extracts From Bulletin No. 88

LAST April I sent out a bulletin describing the results of the giant Hydro-Electric Power System—"HYDRO" for short—of the Province of Ontario, Canada, pointing out that it had achieved a higher degree of efficiency than any large scale electrical development in the United States.

It got more attention than I anticipated. It was reprinted in many American and Canadian newspapers, official bulletins, etc.; requests for copies came from capitalists, engineers, city officials, housewives, students, farmers and who not. The Secretary of a State League of Municipalities recently asked to print it in his official bulletin as information city officials should know.

Also a row developed. Letters came demanding to know how it was done; others asked about profits—if any, some sarcastically wanted to know about how much taxes were levied to cover absolutely certain losses; still others said Niagara River of course is the explanation.

A majority, however, who have discovered from past experience that these bulletins deal with dependable facts, expressed delight and asked, "Why can't we have rates like the Ontario folks", to which the answer is "That's up to YOU".

I don't know of any bulletin of ours in recent years that seemed to produce such a gasp of astonishment as that one. It seemed unbelievable that Mrs. Cullom, for example, could get electric house service in Ontario for $3.55 a month, which would cost $23.18 in Washington, D.C. I gasped myself when I first examined her electric bills.

This Bulletin has been delayed because I desired to utilize the Official Report of the Ontario Hydro System for 1922. It has arrived—a remarkable document of 688 pages. It shows that the amazing efficiency of the managers still continues. As business go-getters they are hummers. They have secured 70,000 new customers, increased the total revenue from $5,419,818 in 1921, to $7,893,979 in 1922, with correspondingly large earnings to the owners, notwithstanding further reductions in rates.

First let me give categorical answers to the chief questions put to me in letters.

YES, the Ontario System is highly profitable to its owners as we shall presently see.

NO, not a single man has paid a cent of taxes on account of this system. On the contrary, it has lowered taxes.

NO, it was not set up by Socialists

or Radicals, but was started and put over by manufacturers, financiers and business men. Such legislation as was necessary was passed by a *Conservative* Government with Sir James Whitney, Conservative Premier from 1905 to 1914.

NO, it was not inspired by sentimentalism. It was a cold blooded business proposition, done for selfish reasons and cash in hand. Incidentally, it has benefited the farmers and the working people more than all the "uplift" chatter, conferences, investigations, academic articles and pious hopes we have witnessed in the United States for a quarter of a century.

NO, results obtained in Ontario are not due to Niagara River. The cost of generating a kilowatt of electricity in a modern power station driven by *coal* is 5 or 6 mills. By water power, 2 or 3 mills.

With these prejudicial things out of the way we may now proceed, I hope with clear minds, to examine the financial structure and organization of a business institution which holds as great a challenge as did the introduction of the modern Trust.

About The Province Of Ontario.

A glance at your Atlas will discover the settled area of Ontario to be about the size of New York State. It has a population of 3,000,000. Its chief cities are Toronto, the capital, 500,000; Hamilton 120,000; London 60,000. There are nine small cities ranging from 10,000 to 40,000. It is a good agricultural, fruit and dairy country and the leading manufacturing province of Canada.

The first fact to note in connection with this story is that *Ontario has no Coal*. Much of it is imported from the United States and a tariff duty paid thereon. But it has Niagara Falls and many other smaller water power sites.

Second, in 1900 its manufacturers, coal handicapped and in competition with the world, sought an advantage—the lowest cost motive power. They were ambitious and had individual initiative plus.

Third, its municipalities, as all others everywhere, were burdened by an increasing tax rate.

Fourth, its farmers were struggling against mortgages, high freight rates, the drift to the cities, the problem of farm labor in the fields and at the house, and other things American farmers know about.

Put these things together, add horse sense and you have the elements of the force out of which came Hydro. Before its inception, Hydro-Electric plants at Niagara Falls, The Ontario Power Company, the Canadian Niagara Power Company and The Hamilton Cataract Power Company, were furnishing electric energy to the eastern end of the province, but the rates were high—8 to 15 cents per kilowatt for light, etc., about the same as in the United States, including the State of New York to-day—and that did not help much. The interior cities had no help at all.

How They Started.

In 1900 some manufacturers and city officials of south-western Ontario began thinking. Please note that. It is of supreme importance. They did original thinking, not re-thinking as

directed by their editor, banker or political boss. As they thought they gained courage. Quite as important. The first man to voice what they were thinking was Mr. E. W. B. Snider, of the little town of St. Jacobs, who, at the annual banquet of the Waterloo Board of Trade on Feb. 11, 1902, in response to the toast "The Manufacturing Interests", said that the inland Boards of Trade and city officials should get together and "secure more industries of a diversified character" for their towns.

If any reader knows of any more sublime passion animating American business organizations than that, please write me at once.

Strong individualist, Mr. Snider also wanted to help "young men to branch out for themselves". And to induce all these worthy ends, he strongly advocated the audience to "take up the question of bringing motive power from Niagara Falls into this district". I quote from the Waterloo Chronicle-Telegraph of Feb. 13, 1902.

First to act was E. B. Detweiler, Vice-President of the Berlin (now Kitchener) Board-of-Trade, who, in May, moved that a committee be appointed to get busy. Replying to this, the President, Mr. S. J. Williams, said, as reported in the News Record:

> "Mr. Williams stated that he did not think the proposition would receive the support it deserved. Toronto had tried to sesure just what was under consideration and they had been fired from the Legislature. Then the Toronto Street Railway had asked for it and got it. If the towns interested put up $5,000, for an expense fund, it would not be a drop in the bucket when they ran up against the lobbyists of such corporations as the Toronto Street Railway and Electric Light Companies.
>
> "Mr. Detweiler believed that figures could be secured to convince manufacturers that it is a good thing and that by the Municipalities working together something could be accomplished."

However, Detweiler and Snider were made a Committee and a month later that Board-of-Trade was holding special meetings and learning from a distinguished consulting Engineer, Mr. Charles E. Mitchell, simple, basic facts about the mysterious and complicated business of generating and transmitting hydro-electric energy. That took courage and patriotism on the part of Mitchell. It was not seemingly good business for the chief consulting engineer of the Ontario Power Company to be imparting such secrets.

Don't get peeved at this recital of origins. It is of importance to know how things came to be. We are victims of an early training. A great indictment lies against our whole educational system—that students are told practically nothing of the truth about the real genesis of institutions. Not one college graduate out of a hundred knows how to appraise a new idea, especially in economics and government. They are trained to exercise no constructive imagination. They accept what *is* and are blinded to what *might be*. And as Talleyrand said, "History is a lie agreed to".

What these Ontario business men learned from the engineer, astonished, delighted and encouraged them. On Feb. 17, 1903, delegates from Trade Boards and officials from several cities, met at Kitchener and laid plans for action. Attending this meeting was an able, wealthy box manufacturer of London, Mr. Adam Beck, who said he "came to learn". He learned, caught fire with the idea, became its knight errant and in 1914 was knighted by the King of England for distinguished public service in this field.

It would appear that by this time these business men were thinking about like this:

FIRST—Hydro-Electric power is needed to bring new industries to our towns, increase our own profits and lower taxes.

SECOND—The existing power companies won't furnish us power.

THEREFORE—Let us do it ourselves.

But said they, let us get more official facts about this electrical business, tell everybody. They don't know much now.

Stick a pin here. These men were not soap-boxers or half baked idealists in this world of realities and lies. They used wisdom, started slowly and did not ask people to back up a scheme before those people were in possession of facts that could not be controverted. A concrete foundation of sound opinion was thus laid.

A few days later, a large delegation from several Municipalities appeared in Toronto, laid their case before Premier Ross and he promised support.

They did not ask for *Government Ownership*. They did ask for a bill to enable the interested cities to inquire into the supply and distribution of electrical energy. The bill passed, the cities appointed a commission of four able business men and an electrical engineer. It went to work and in 1906 made a comprehensive report of so conclusive a character that it revolutionized the thinking of progressive Ontario business and public men and became the basis of the Act of 1906, passed by the Conservative Parliament under the leadership of the Conservative Premier, Sir James Whitney. On this Act and subsequent additions, Hydro is founded.

Three years had passed. New knowledge had come and the business men, manufacturers and public officers of this experiment were now talking thus.

The Niagara River is OUR River. Companies to which we have presented the right to utilize a part of our river are making huge profits on inflated capitalizations, hence the high rates. Let us have a new deal, form a partnership of Municipalities and make some profits for ourselves out of our river. Competition is recommended by all economists as a good thing. Besides, we have a sacred right to use our own property when we don't take theirs.

Anyhow the Act of 1906 provided

for a voluntary partnership of municipalities empowered to go into the electrical business. It was to function through a central commission which was granted sweeping powers and put on terms of equality with any other business concern. It was named "*The Hydro-Electric Power Commission of the Province of Ontario*". Its first Chairman was Mr. Adam Beck, who has been Chairman ever since. Another member was Mr. P. W. Ellis, Capitalist of Toronto, who is still in harness and now Chairman of the Toronto City Commission.

The Partnership Begins Business.

It was decided to go slow at first and let the plan demonstrate itself. So the Commission instead of building its own generating plant, bought power from existing companies. It proceeded with the construction of its own long distance high-power distribution wires.

In 1910 fourteen cities had joined the partnership, each contracting with the Commission for its supply, the total being 26,000 horse-power.

October 11, 1910, was a gala day in Kitchener, when the power was first turned on in the town where the idea first took fire. 8000 people, including many of Ontario's leading men, were present.

Several Americans were there who apparently went back home and forgot about it. Sir James Whitney, the Premier, in "pressing the button" did a graceful thing. He first placed Adam Beck's finger on the key, placed his own over it and started in this town of 15,000, what is now the greatest electrical development in the world.

And Adam Beck deserved the recognition. It was not the politicians but the business men and city officials led by Mr. Beck who had turned the trick. For eight solid years they had fought every conceivable kind of lie, false prophecy, underhand scheme and political and financial influence the existing interests could devise. They won because they had first educated the people, and the newspaper bug-a-boos and solemn warnings of distinguished citizens were laughed at. To this day, these same business men have never allowed the politicians to touch the management of Hydro; just as the business men of the United States seldom permit the political bosses to impair the efficiency of their fire departments. Ponder that.

Hydro was a success from the jump. By 1912, it was perceived that the Commission must prepare to furnish power in much larger blocks than the companies could possibly sell them. Profitable as their enterprise was, they saw opportunities to make it still more profitable.

Business Is Business.

The same shrewd thinking continued. Business is business. They said:

> The current accepted method of financing a power Utility Corporation is to get a water power site free, invest say $10,000,000 actual cash in equipment, capitalize the whole thing at say $30,000,000 and charge rates to pay dividends on that.
>
> At the end of 30 years, and so on forever, the $30,000,000 "capitalization" still stands and

high rates continue, although the users have paid for the investment several times over for the use of their own water.

That's fine business for those who own the corporation, but it's not good business for those who own factories, stores, offices and homes and who pay taxes for city lighting and power. There are a few more of us than of them.

Why not use our own river, invest $10,000,000 in equipment, pay it off in 30 years out of rates charged which will be high enough to include interest, depreciation, operation and all the requirements of sound finance?

We will then own the plant free of debt.

Rates will drop as sinking fund installments are paid off and interest stops. Out of every $10 we now pay for juice, $8.50 goes to capital and $1.50 to operation.

So they started to build the now famous Queenston-Chippawa plant to cost $10,000,000 and have a capacity of 100,000 horse-power. Then came the war. Canada began manufacturing war supplies. Coal was hard to get from the United States. Prices were enormous. The Canadian Government urged the Ontario Power Commission to rush their plant. No one knew how long the war would last. Ontario responded. Plans were enlarged and the result was an electrical generating plant that will, when complete, furnish Ontario with 600,000 horse power. The three generators in use are taxed to their capacity and the rapidly increasing demand, both from home users and so many new factories locating in Ontario, indicates that even this great plant will not give energy enough by the time it is completed.

But let us not forget that in addition to Niagara, there are 13 smaller systems scattered over the province all owned by, and under the unified direction of Hydro.

This little official table will give you an idea of the success of this new kind of business partnership which now has an actual investment of over *two hundred million dollars.*

The Growth of Hydro Service.

1910	750 horsepower	10 municipalities
1915	104,000 horsepower	112 municipalities, 120,000 consumers 18 townships
1921	305,000 horsepower	234 municipalities, 265,000 consumers 44 townships
1922	544,000 horsepower	242 municipalities, 335,000 consumers 74 townships

The Partnership Proves Profitable.

The new method of finance has proven highly profitable. The accountants estimate that from 1910 to date, it has been worth at least $100,000,000 to its owners. And they have a very handsome and agreeable method of distributing the dividends. There are two ways in which this might have been done.

> First, they could have charged the householders, manufacturers, municipalities, etc., regular standard prices which were the same in Ontario then as they are now in the United States. Say 10 to 20 cents for house light; $25 to $80 per horse power for factories; and after paying fixed charges,have distributed the surplus. If too high, they might have declared a stock dividend.
>
> Or, they could ascertain the cost of production, which of course includes sinking fund and interest charges, depreciation, operating expenses, etc.—and then charge 2-3-4-5-10 cents for house light (whatever the exact cost of furnishing it in each locality proved to be)—$12 to $40 for factory power, collect that and permit the owners of the system to keep the profits in their pockets from the start.

The latter rate is the one in use and proves quite popular. It is also efficient and saves much book-keeping. Besides, one always knows about what one's dividend is going to be—which is pleasing to human nature.

And one does not have to wait for several years, as the patrons of the Potomac Electric Light and Power Company of Washington, D.C. are now doing, to ascertain whether a Court of Justice will permit some $4,300,000 of their money to be returned to them, which has been collected in the form of excessive rates since 1917 in spite of a reduction from 10 to 8 cents a kw-hr, ordered by a Public Utilities Commission. Such six years delay are against human nature in Ontario, so they have fixed things so they don't have to pay the salaries of, or bother with, commissions and courts in such matters.

To get a concrete idea of what these profits are like, let us take some samples from the Official Report of 1922, and other official sources.

London had 13,993 domestic consumers. Average use per month—74 kw-hrs (and a large percent. of the housewives cook, wash, sweep and iron by electricity), average bill—$1.34. Prior to Hydro this bill would have been $6.91, so Mrs. Housewife's monthly dividend from Hydro was $5.57 or $66.84 for the year.

Windsor, opposite Detroit, 250 miles from Niagara, had 1472 commercial users last year. Average monthly consumption—217 kw-hrs, average bill $5.90 per month. Old time standard cost $17.36. Monthly dividend—$11.46, or $137.52 for the year.

Toronto has 2659 power users, big and little. They used to pay around $60 per horsepower for shop and factory use. Average rate last year was

$22.58. American manufacturers being quick at figures can estimate profits.

In 1921, 212 municipalities, big and little, partners in Hydro, paid a total of $1,060,358 for street lighting and $654.531 for water pumping and other city power. Since former standard prices to companies, or high coal rates for their individual plants made this service cost from two to five times as much, it is evident that the taxpayers of Ontario made a gain of at least $3,000,000 that year, and still more in 1922.

In 1920 Buffalo taxpayers paid $584,779 for street lights; Toronto, about the same size, paid $335,370 and had *three times as many lights.*

"Foolish", says someone, "These people had *invested* nothing. Why talk of profits?" Oh yes they had. They had invested their municipal credit. On that they borrowed money to build their equipment. They set up no fictitious capitalization. Each time Mr. Average Merchant of Windsor pays his monthly bill he knows that a part of the money goes to the sinking fund, a part to interest, to depreciation, to operating expenses, etc., in standard business fashion to run the plant in which he is a partner—that all is cared for out of rates, nothing from taxes. He observes rates coming down as the bonds are paid off, not refunded—and year by year his investment grows more profitable to him in the shape of cash in hand. Call it saving or dividend as you like. The Bank Balance is no respecter of tag words by which humans are so easily fooled.

Had Windsor people not invested in Hydro, and still had let us say "The Windsor Power Company" serving them, Mr. Merchant could have paid his lighting bill in this way. He could have bought $3000 of 7% company bonds, paying him annually $210 profit, which would have just paid his bill of $208.32. He knows further that no taxes have been or will be levied to support Hydro, and further that none of the money he does pay for taxes will go to maintain regulatory City or State Public Utility Commissions.

The Financial Structure.

It will be profitable here to consider briefly the basic principles upon which Hydro is operated. Those expecting some complicated fiscal structure will be surprised at its simplicity. I quote from page 191 of the 1922 Report of the Commission:—

> "The basic principle upon which the whole Hydro project is founded is set out in the contracts under which the municipalities enter into the partnership of which the Commission acts as trustee. The rates at which power is supplied to the various municipalities vary with the amount of power used and the distance from the source of supply. The entire capital cost of the various power developments and transmission systems are pro-rated annually to the connected municipalities according to the relative use made of the lines and equipment. Each municipality is required to assume responsibility for just that

portion of capital employed in delivering electrical energy to it, together with such expenses as are incident to that particular portion of the investment. Municipalities are not charged with expenses connected with equipment or plant from which they derive no benefit or are in no way interested. The entire annual expense of operation, maintenance, administration, interest and sinking fund and full depreciation are paid out of revenue collected from the municipalities, through the medium of thirteen power bills rendered by the Commission each year. Power bills are rendered at an interim estimated rate each month during the year and a thirteenth bill—or credit memorandum as the case may be—is rendered at the end of the year, when the Commission's books are closed and the actual cost determined. There is no burden on the taxpayers or on non-users and no avenue through which losses, should they occur, could be absorbed, except by a direct charge to the contracting municipalities for power supplied. It should be noted that the sinking fund on the debentures is treated as an operating expense, and that, therefore, the municipalities are not only paying the interest on the investment, but are also paying off the principle by means of a sinking fund and, in addition, are providing for the perpetuity of the system through an adequate depreciation fund".

Another basic principle laid down from the beginning by the business men who started this enterprise and vehemently believed in, and enforced by the Commission, is that there shall be no "politics" in its administration. There has been none. It is too vital a factor in the life of Ontario for the people to permit it. In fact, a moving cause of the overturn in the late election was the suspicion among the people that the former administration was desirous of bringing Hydro within the political sphere.

It would be a pleasure to speak of the efficient corps of engineers, executive officers, accountants and experts of all kinds with whom I met while up there, and to try and give my skeptical American friends a hint of the energy, intelligence and passion for service which animates these men. But that would take a whole bulletin in itself. Never in Europe or America have I seen a finer example of loyal team play in any kind of an institution.

No Confiscation.

No electrical company has ever been arbitrarily forced out of business by Hydro. Property rights have been strictly held "sacred". The law of competition has also been held sacred—and permitted to actually work. This is what happened; there are a few large private plants still operating, the rest have sold out to Hydro. The Ontario Power Company is now owned by the municipalities. The small individual plants over the province had hard work competing with the modern Giant Power method of doing things. The chief cause how-

ever has been that as soon as a concern with inflated capitalization had to compete with Hydro which carried no "water", the jig was up, it quit the field and sold to Hydro.

Two systems of finance have been in conflict in Ontario, as to this utility, for some fifteen years. As a captain of industry, Sir Adam Beck must rank with John D. Rockefeller. John D. created the American Trust; Sir Adam the Municipal Partnership. John D. has the biggest oil concern in the world; Sir Adam the greatest electrical enterprise. Both saw the necessity of doing things on a large scale. Both unified production and distribution, eliminated waste and brought down the unit cost. Both have made huge profits. John D.'s profits are in the hands of himself and a few hundred stockholders. Sir Adam's profits are in the pockets of the thousands who have patronized Hydro. John D. is always scheming to keep oil up; Sir Adam is always fighting to bring electricity down. John D.'s system corrupts government; Sir Adam's works just the other way.

The people of Ontario have learned what to do with a natural resource. They have a Water Power Policy. You may as well ask them to invite Kaiser Bill to rule over them as to suggest that they turn their water power over to an old fashioned corporation to "develop". They have conservation plus, confidence in themselves, long range vision—and would scorn asking even a Henry Ford to lead them into the Promised Land. Not being civic children they know how to get there themselves—and have money, fertilizer, light and power to begin operations when they arrive.

Is It Financially Sound?

"All very fine," remarks some level headed Business Men. "But these Hydro rates look suspiciously low. Is it financially sound? Will it blow up? What is the story of the Balance Sheet?"

Well the Annual Reports of the Commission for several years past have told everything down to the minutest details about finance, engineering and construction. The report of 1922 makes a volume of 688 pages, of which 335 pages deal with *"Financial Statments"*, from the status of the sinking fund down to the cost per kw-hr. in the remotest farm district. These accounts are kept by a Standard System and are checked up annually by Special State auditors. Their accuracy cannot be seriously questioned and no reports on the continent are more searchingly examined by hostile critics everywhere.

For this brief bulletin the following must suffice:—

As to the *wholesale* end; the gross income to the Commission from the municipalities for 1922 was $7,983,979; the gross cost of generating and distributing it was $8,049,799. *Now note!* "As is its custom, the Commission at the beginning of the year determined a schedule of rates to cover the estimated cost of service to all municipalities. After meeting *All Obligations* in accordance with Section 23 of the Power Commission Act, the expenditures and reserves exceeded the revenue by $155,819 or 1.97 percent. This 13th. amount was billed to the municipalities so that the Commission's balance sheet with the

municipalities shows neither profit nor loss."

That is, at the beginning of the year the engineers and accountants of the Commission made an estimate—the best guess they could as to what the cost for the year would be and fixed an *ad-interim* rate. They came within 1.97 per cent. of it on an $8,000,000 business. Under it this time. Had it been 1.97 per cent. *over* the cost the Commission would be sending checks *to* the municipalities to refund what they had overpaid during the year.

The report states:—"Of the 214 municipalities included in this report, a total of 24 failed to meet their actual cost of operation without regard to depreciation. A total of 42, including the above, failed to provide full theoretical depreciation in addition to all operating and maintenance expenses, but their relative unimportance is clearly disclosed by an examination of the reports. These 42 municipalities indicate a total theoretical loss of $135,004.40, while the 172 remaining municipalities piled up a surplus of $830,341.70, thus leaving a net surplus from all Hydro municipalities of $695,337.30 during the year". (P. 294 of the Report). The ratio of net debt to total assets for all cities was 65.6 per cent. for 1922 as against 80 per cent. in 1913.

To recount, so that this will be perfectly clear.—The experts of 42 municipalities *under guessed* the local rate necessary, so in 1923 the rates will be slightly increased to make up for the deficit. The experts of 172 municipalities *over guessed* the necessary rate, so in 1923 the rates will be lowered in these cities and the surplus thus redistributed to the consumers. A close study shows that the 42 showing a temporary deficit were small places and most of them have but recently joined Hydro. Keep in mind all the time that the principle is to furnish energy at cost and leave in the pockets of the consumers the profits of the system as would accrue if the system charged standard prices as prevailed in Ontario prior to Hydro, as prevail to-day in Montreal and most other Canadian cities and as are charged and allowed by City and State Public Utility Commissions in the United States. Hydro is sound as a rock.

Some Interesting High Lights.

The rates are fixed so that the bonds will be paid in 30 years. However, I find that even with the low rates charged some have not chosen to go as low as they could and 18 municipalities have piled up surpluses to equal their capital obligations and are now "out of debt". The report predicts that 32 others will reach that happy state in 1923, so that practically we may say that *fifty* partner cities are now in the *"out of debt"* class.

The lowest cost to consumers in 1922 was in St. Catharines—1.3 cents per kw-hr.

In Bulletin No. 83 I noted the domestic rates paid in large cities. Let us bring this up to date.

	In 1921	In 1922
Less than 2¢ per kilowatt hour	9 cities	13 cities
" " 3¢ " " "	13 "	25 "
" " 4¢ " " "	23 "	25 "
" " 5¢ " " "	20 "	21 "

There is a great increase in the use of all sorts of domestic appliances by electricity. The electric ranges are being installed at the rate of 1,000 per month.

Finally As To "Taxes".

Taxes are lowered because municipal lighting and power costs less under the new system, *but* private corporations pay taxes; does Hydro pay taxes? The Commission pays the Province for the use of the waters. The local Commissions pay no taxes. How much then do the cities lose? I had that figured out. If in 1921 Hydro in Toronto paid taxes like a private utility it would have added 43.7 cents to the yearly expense of each domestic user and $1.53 for each commercial user. But since the average domestic consumer *saves* $35.67 and each commercial user $186.99 every year, as against the price they would have had to pay the old private company for the same service, you can understand why I never heard anything about "TAXES" while I was in Ontario. Solicitude about this item of taxes is all on this side of the international boundary line, especially on the part of such acute minds as William S. Murray, noted engineering expert employed by the National Electric Light Association, to give an angelically unbiased account of Ontario and his alarm over taxes brings tears only to the eyes of such civic morons as are mentally capable of holding but one idea at a time and are hence unable to check up on Murray.

According to Mr. Murray, Ontario lost in 1920, $762,120 on account of Hydro's not paying taxes enough. But since the electric consumers of the Province saved, as an extremely modest estimate, at least $10,000,000, it would appear that Mr. Murray's conception of sound finance is that people pay, say $13 unnecessary rates to a Utility Corporation in order to have the grand opportunity of once a year standing on the steps of the City Hall and watching the Corporation's office boy pass by with $1.00 for deposit in the City Treasury as *"TAXES" ! ! !*

I regard the Murray report, whether dealing with the technical or economic aspect of Hydro, as a travesty upon the engineering profession, an insult to the American people and an outrage upon the Province of Ontario. Furthermore, it is the most illuminating bit of evidence as to the real character and purpose of the National Electric Light Association with which that distinguished body of devotees of pure science has yet favored us.

What Moody Reports.

When an investor, bank president or credit man wants to know the financial standing of any utility corporation on this continent, he consults "Moody's Manual". Next to his hope of Heaven a utility director desires to see his concern rated "Aaa" by John Moody. In rating bonds, John has no more sentiment than a chemical test tube or a Japanese earthquake. Hence the universal confidence in his Manuel.

Turn to page 1622 of the current Moody and *you will find Ontario Hydro bonds all rated Aaa.* Go back to the key where symbols are explained and you will read, "Bonds carrying Aaa rating meet the highest tests in

asset values, earning power and stability....and fall under the general classification as *the highest grade*".

WHAT ALL ONTARIO THINKS.

Ontario has confidence in Hydro. How do I know? I'll tell you. Back in 1908 to 1910 the people of 29 municipalities installed Hydro by an average vote of 3 to 1. That was when things were starting and these hard headed, conservative people went slow and wanted to be shown. By 1912 the municipalities were voting for Hydro at the rate of 6 to 1. Since then it has been installed at an average vote of 14 to 1, and in many places by a unanimous vote. And let us remember that bankers and manufacturers and business men as well as poor people have *votes*.

Here you have all of Ontario's answer to the world as to how it regards HYDRO.

The Eyes of the Store

HAVE you ever done any window shopping? If you haven't you are probably not married, because no married man ever got downtown that he wasn't compelled to make the rounds. Some one has called window shopping cheap amusement; you can bet your life it isn't! True it doesn't cost you anything but time while you are window shopping, but the next day when the shops are open is another story. Friend wife invariably spots something she wants or believes she needs, and you can place a bet that she never forgets in which store window she sees it. The store window has been the Waterloo of many a bank account.

Window shopping is a lesson in the value of good displays, and their effect on prospective customers. Have you ever watched other people window shop? Just try it some time. Listen to their remarks. Notice the stores where they carefully study the displays, and the ones which get only a passing glance, sufficient to show the shopper that they are uninteresting.

The remark has often been made

that the show windows are "the eyes of the store." I contend that they are the whole face of the store, and a wonderfully expressive face at that. From the show windows it is possible to secure a good character analysis of the proprietors—their business policies, integrity and progressiveness are expressed every day in their show windows. If you had never been in a Five and Ten Cent Store, a casual glance would show you that you would not expect to buy an expensive article in the store. The show windows portray the character of the business, and show you that only small articles are handled there. Following the same line of reasoning, you would not enter a handsome jewelry shop to purchase a ten cent piece of imitation jewelry; the windows tell you that your quest would be out of place there. When you go to buy something you invariably look in the store window before entering. Why? To make sure you are going to the right store, and possibly to see if the goods you want are displayed. The windows instantly tell you if you are going to the right store; if you want tooth paste and the window in which you look contains hardware, you of course do not enter the store; its character is apparent without question.

The word "character" has, I find, ten different definitions. As used above it would mean "appearance or outward trait viewed as a token of real nature, origin, or the like." However, in this sense the character of the store could be determined without windows, by means of a sign stating the business. Let us go further; we find that "character" also means "quality, position, rank or capacity; status." And this is the character that can be portrayed only in the display window; no sign would suffice.

But the facility with which the passerby can read the character of the store through its show windows may be either an asset or a liability. We have all had the experience of observing a man, possibly in a train or a public place, who impressed us so favorably that we at once wanted to make his acquaintance, to know him. An attractive appearance, which is "surface character" instilled this feeling. You may be fortunate enough to meet the person who thus impresses you; you talk to him and find that your first reaction was well founded; he is successful in business, has many friends, and is an all round "100% man." Of course, there is always the possibility that you were disappointed when you met him; that his character was all "surface" with nothing behind it; but I have found that this is the exception, rather than the rule.

In contrast to the person who almost invariably impresses people favorably, you probably have a speaking acquaintance with the man who never creates any desire to know him better. Undoubtedly he is careless in his dress, wears soiled linen, shaves but twice a week and is generally unattractive in his aspect. What, then, is your surprise, when on the first occasion you

have to really talk to him, you find that his personality and character are wonderful, and that he is a man well worth talking to! You discover that he is just fairly successful in business, and has a few friends. You wonder why. It is his unfortunate appearance, or "surface character," which repulses rather than attracts. His friends appreciate him, but they became his friends through chance. Every day he loses opportunities to "sell" himself, because his "show window" is not a true index to his character, and "his customers are not coming in."

How true is this where the windows of a store are concerned! The store itself may be above reproach, but if its true character is not shown in its display windows, people will pass by without any desire to investigate, to learn its real worth. It will make friends, but slowly, and will find it an uphill road to success. Good show windows, well lighted and properly trimmed, will establish the store's position and rank in the community. People realize that the window displays reflect the business policies, integrity and progressiveness of the concern.

—"Contact".

Many Big Lighting Campaigns Are Now Under Way

The Society for Electrical Development, Inc., general offices, 522 Fifth Ave., New York, N.Y., reports an ever-growing interest in the subject of Residence Lighting and Store Lighting campaigns in which it has been very active.

From data on hand it is estimated that in over 100 large and small communities, individual concerns or co-operative organizations are starting educational, sales, and advertising "drives" to fully inform the public of the tremendous benefits of Better Lighting in home, office and store. The latest returns available from New York, Philadelphia, and other cities are highly encouraging to those piloting this very important work.

The S.E.D. stands ready to serve the industry in the promotion of lighting activities and wishes to bring to the notice of all lighting men the very complete advertising and sales material prepared and available for both residence and store lighting activities.

While it is not possible to go into full details regarding this effective material which is being used in scores of lighting campaigns at the present moment, the following brief outline will give some idea of the service the S.E.D. can render on this phase of development work:

I. (a) Residence Lighting:

A 96-page monograph, comprising an analysis of the market possibilities of Better Residence Lighting; methods of "surveying" local possibilities; forms for use by individual and co-operative organizations; lecture courses; advertising copy, cuts, layouts, etc.

(b) Interior Sunshine:

A 12-page consumer booklet for use by local companies in creating a demand for better residence lighting.

(c) Happier Homes:

A very delightful brochure on the proper luminaires for the "Home Beautiful". This booklet has been called a happy presentation of the better fixture idea to better homes.

II. (a) Store Lighting:

A 96-page monograph giving the results of the sales building possibilities of better light in show windows and store interior, the business that will accrue to central stations and other related branches of the industry engaging in the development of this lucrative business; effective advertising and sales helps, etc.

(b) Building Store Profit With Light:

A booklet for distribution to store managers—summing up the benefits to business houses utilizing better store lighting, and containing the testimonials of enthusiastic merchant "lighting fans" from all parts of the country, in all kinds of businesses.

(c) Three, large mailing broadsides, selling the idea to the merchant that better lighting pays big dividends; to be mailed in conjunction with the other store lighting advertising aids.

(d) "Better Lighting In Store And Office An Asset To Business."

A companion-piece of consumer literature for use in conjunction with a commercial building and store lighting campaign. This latest publication—fresh from the press—has already been used at the store and office building lighting exhibit in Minneapolis.

Copies of all this material are available at nominal prices, write to the Society at the address given above.

Never before have the compound benefits of Better Lighting been hammered home so vigorously by all branches of the industry—never before was the opportunity so ripe for all branches of the industry to reap the benefits of the vast amount of educational work which has been forwarded the S.E.D. in co-operation with other agencies.

Three Letters That Tell Their Own Story

May 8, 1923.

Attention New-Business Manager,
Brown Electric Company.
Gentlemen:—

Under separate cover I am forwarding to you photostats of the contemplated house wiring which I am planning to install in my father's home, 51 Jones Avenue, during my vacation the last two weeks in June. My purpose in bringing these plans to your attention is that possibly you might suggest some further additions or conveniences I have overlooked in the wiring of this house. Any suggestions or criticisms you may desire to make will be appreciated.

Another matter on which I should like further information is this: Does your company handle the housewiring contracts directly or through some local contractor-dealer? If you do the wiring yourself, have you any deferred time-payment arrangement? I shall appreciate your advising me what system your company uses.

Very sincerely yours,

John Doe.

May 29, 1923.

Mr. Richard Roe, Manager,
Brown Electric Company.

Dear Mr. Roe:

Not having received any reply from my letter addressed to your new-business manager relative to your rates on house wiring, I am writing you direct for further information on this subject. On May 8 I also sent along some photostats of the contemplated house-wiring plan which I intend to install in my father's home at 51 Jones Avenue, during my vacation the last two weeks in June. My purpose in bringing these plans to your new-business manager's attention was that possibly he might have some suggestions in regard to the addition of more outlets or conveniences. Since the time is growing short between the end of June and the present, I shall appreciate any suggestions and criticisms you might make on these plans. If these plans have miscarried in the mails, I can furnish you with an extra copy.

Another item on which I wanted some more information was this: Does the Brown Electric Company handle the house-wiring contracts directly or shunt them to local contractors? And if you do the wiring yourselves, have you any arrangement on deferred time payments? The reason I wanted this work done during my vacation was that I could possibly help in the work and direct some of the construction since I wanted the installation finished before I must return to my work.

I will appreciate most keenly any information you can give me on this matter since I would like to let the contracts as soon as possible in order to start the work by June 19.

Sincerely yours,

John Doe.

May 31, 1923.

Mr. John Doe

Dear Sir:—

Answering yours under date of May 29, I beg to advise that no communication from you has been received at this office.

Very truly yours,

BROWN ELECTRIC COMPANY,

By Richard Roe, Manager.

—Electrical World.

A. M. E. U.
Results of Primary Ballot

The scrutineers have reported the following list of nominations for officers of the Association for the year 1924. *These names are to appear on the Election Ballots.

PRESIDENT:

*J. E. B. Phelps, *V. S. McIntyre, R. H. Martindale, O. M. Perry, W. E. Reesor, R. H. Starr, H. O. Fisk.

VICE-PRESIDENT:

*W. E. Reesor, *J. J. Heeg, V. S. McIntyre, R. H. Starr, W. R. Catton, P. B. Yates, E. V. Buchanan, O. M. Perry, H. H. Couzens, R. H. Martindale, P. Pocock, E. I. Sifton, W. G. Ferguson.

SECRETARY:

*S. R. A. Clement.

TREASURER:

*G. J. Mickler, *A. E. Clark, D. J. McAuley.

DIRECTORS AT LARGE:

*M. J. McHenry, *O. H. Scott, J. J. Heeg, *P. B. Yates, *R. H. Starr, *W. R. Catton, *O. M. Perry, V. S. McIntyre, E. V. Buchanan, C. C. Folger, E. I. Sifton, J. G. Jackson, R. J. Smith, E. J. Stapleton, J. G. Archibald, E. H. Caughell, G. E. Chase, R. H. Martindale, E. M. Ashworth, A. B. Scott, A. W. J. Stewart, W. H. Fairchild, H. O. Fisk, J. R. McLinden, J. E. B. Phelps, A. A. Smith, V. B. Coleman, Wm. Mount, J. E. Teckoe, A. Broad, E. S. Frost, E. R. Smithrim, M. M. Inglis, S. A. Saylor, J. E. Brown, B. W. F. Beavers, A. H. Lloyd, G. F. Harrington, R. O. Quick.

DISTRICT DIRECTORS:

Niagara District:

*J. G. Archibald, *E. I. Sifton, M. J. McHenry, E. S. Frost, O. M. Perry, W. R. Catton, J. W. Bayliss, E. H. Caughell, J. G. Jackson, Wm. Mount, A. C. Clemens, W. L. Millar, J. Vining, W. H. Fairchild, J. E. Teckoe.

Central District:

*J. E. Skidmore, *H. O. Fisk, V. B. Coleman, G. E. Chase, W. E. Reesor, F. C. Adsett.

Georgian Bay District:

*E. J. Stapleton, *J. R. McLinden, Jno. Hayne, J. A. Foerster.

Northern District:

*R. H. Staford.

Eastern District:

No Nominations.

Be Sure to Come

A. M. E. U. CONVENTION

at Carls-Rite Hotel, Toronto

January 24 and 25, 1924

Notes on the Selection of Lighting Glassware

By Geo. G. Cousins, Assistant Laboratory Engineer, H.E.P.C. of Ontario

THE selection of lighting glassware is one of the most important steps in the solution of every lighting problem in which glass is the material decided upon to produce the required modification of the light generated by the lamp.

The utilitarian requirements are that it should be efficient and effective in its distribution of light and should be kept in a clean condition without excessive labor. Psychology demands that it should limit the glare to an acceptable degree, present a pleasing appearance, provide the proper quality of light and produce a general overall cheerful atmosphere to the interior which it is to light.

The three principal functions of lighting glassware are to shade, diffuse and redistribute the light generated by the lamp: a fourth function is to modify the color of the light.

Lighting glassware falls into one of four main types: opal, prismatic, mirrored and roughened crystal (except purely decorative types many of which are difficult to classify). Roughened crystal is the cheapest and least satisfactory of any and cannot be recommended for any but the very lowest class of service.

In the following discussion the chief consideration will be to those types of glassware that are used in the lighting of stores, offices, public buildings, schools and some types of factories and those interiors where the utilitarian requirements predominate.

Possibly the type of glassware most commonly met with is the opal diffusing glasses of which there is an almost endless variety both in style and quality. It is realized that the term "opal" is wrongly applied to many translucent glasses that are not truly opal glasses but as the word as applied to lighting glassware has not been well defined the term is used here for want of a better one to designate all white translucent glasses. These glasses all possess two opposing characteristics, transmission and diffusion. To obtain excellence in either of these the other must be sacrificed although the amount of this sacrifice differs very much with different

makes and kinds of glass. It has generally been the case that a glass that produced good diffusion had a low transmission factor or in other words absorbed a large percentage of the light or vice versa. Opal glasses are usually of the light density or the heavy density type which produce high transmission and poor diffusion or low transmission with good diffusion, respectively. There have recently appeared a few notable exceptions to this in glasses that produce nearly perfect diffusion with transmission factors as high as 85%.

Heavy density glass is a much better reflecting material than light density and on account of this is usually the better glass to use for making semi-indirect bowls. A bowl of heavy density glass gives a greater percentage of light flux in the upper hemisphere than a light density bowl does. This results in a closer approach to indirect lighting and is much less glaring than a light density bowl.

Heavy density glass is much the better for use as direct reflectors because of its greater ability to reflect light, as a consequence the brightness of its exterior surface is much lower than a similar unit of light density glass.

From the standpoint of glare the choice should be for heavy density glass in reflectors both inverted and direct.

Diffusion is usually a very desirable characteristic that results in a soft pleasing appearance of the lighted area as a whole due to the subdued nature of the shadows. The lighting of a room is rendered harsh or pleasing by the character of the shadows.

A great advantage possessed by opal glasses is the facility with which ornamentation may be molded into the design of the unit so as to conform to any style of architectural decoration without sacrificing its utilitarian features.

Other types of glassware that are very widely used are known as prismatic and mirrored. Prismatic glassware is of crystal glass molded into such forms as to render possible the employment of the principles of internal reflections in the glass, as by prisms and by refraction or bending of the rays of light as they pass through the glass, either or both of these principles may be used in one unit. Mirrored glass is as its name implies a glass blown or molded into suitable shape and one surface, usually the exterior is coated with silver.

Whereas the degree of control of light from opal glass is very limited, practically any desired result can be obtained by prismatic and mirrored glass units. The principles upon which they are designed are subject to strict optical laws. The most noticeable difference between the two latter types is that the prismatic is translucent and the mirrored is opaque. Each of these features has its advantage for certain uses. These types of glasses are designed to direct the light to where it is needed and to exclude it from zones where it would be objectionable. As a consequence their efficiency is very high.

A comparatively new type of glassware that has many desirable features and is becoming popular is the enamelled crystal glass enclosing units. These are usually of the totally enclosing form with the lower part

coated with a moderate density diffusing enamel to conceal the lamp itself and the upper part is coated with a dense enamel to act as a reflector. The part connecting these two areas is left clear for the unobstructed passage of the reflected light from the top. This type has the good features of the semi-enclosing 2-piece unit with the added advantage of being practically dust-proof. A modification of this type of unit is one whose general appearance is that of semi-indirect bowl. The glass itself is blown so that the lower surface exposed to view is enamelled and the top part is left clear. This results in a dust-proof semi-indirect unit. There are great possibilities for units of this type and in all probability they will increase in popularity. As a type they are more flexible in their adaptability than the opal glass types. Where tinted bowls are desired the tint can be incorporated in the enamel and by coating the glass with a dense white enamel and spraying, the tinted enamel on to this, the reflected light from semi-indirect bowls is not altered while the bowl itself may be made of any color.

The matter of choosing a type of unit for a particular installation calls for the greatest skill and judgment on the part of the engineer and it is in this phase of lighting that a knowledge of the various kinds of glassware is invaluable. Consideration must be given to the character of light distribution required to fulfil the needs of the installation. In most offices and schools the most important plane to be lighted is the desk plane and enough light will find its way to the walls and ceiling from any translucent reflector to provide the desirable cheerfulness of atmosphere.

In many stores the situation is different and walls require about as much illumination as the top of the counters. It is in this field where the characteristics of enclosing globes are especially applicable.

Most of the requirements mentioned call for light approximately white, such as is produced by unmodified tungsten light. Stores and industries frequently require a closer approach to daylight and to supply this need there are enclosing globes available which are made up of a thin layer of bluish glass on the inside of an opal globe. Such glassware appears white when the lamps are not burning and when they are lighted the bluish interior produces a whiter light than would otherwise result. This light however is not a color matching light. It does however blend well with daylight and renders the presence of artificial light less conspicuous. For some purposes as in tea rooms and certain confectionary shops a warm restful atmosphere is desired which may be produced by spraying tinted pigments on to opal or white enamelled bowls. To tint all the light in a room involves a considerable loss of light but the suggestion of color can be produced with a negligible loss by tinting the exteriors of semi-indirect bowls provided that a good white reflecting surface underlies the tint.

The height of the interior governs the height of the unit above the floor and this in turn has an important effect on the glare feature. When the suspension height of the unit must be low great care must be exercised to select glassware that will have a low

surface brightness. The zone between the horizontal through the unit and 30° below is the glare zone and it is particularly important that the brightness in this zone be kept low. In regard to this it is useful to bear in mind that the surface brightness of large globes is lower than of smaller globes of the same glass and for the same lamp. This is because the larger globe possesses a much greater surface area than a small one and as the same amount of light is emitted by each the amount of light for each unit of surface area becomes smaller as the globe size increases.

This is a rule pertaining to surfaces whether transmitting or reflecting light, that is, the greater the area the lower the surface brightness for a given total amount of light flux. A school board of a large city recently specified that no globes were to be smaller than 16″ diameter.

As a general rule direct lighting reflectors are the best type for mounting close to the ceiling and if these are of opal glass they should be of heavy density.

While there is a lamentably small choice in opal glass reflectors there is a fairly large range of globes to choose from. In fact the Canadian market offers only one type of translucent reflector of the opal group and that is the least suitable for the needs of the illuminating engineer.

In summarizing the foregoing it may be said that the opal glasses lend themselves readily to the design and production of ornamental lighting glassware and are particularly suitable for service where vertical as well as horizontal illumination is required. The degree to which they can redirect the light into specific zones is comparatively limited.

The 2-piece semi-enclosing units and their totally-enclosing enamelled glass rivals are about on an equal as regards their control of light and are slightly more effective in this respect than the globes. The dust-proof feature of the latter style reduces the labor of maintenance. The enamel or lacquers which are made up with inorganic pigments possess remarkable properties of resisting deterioration due to heat or washing and are practically permanent.

Where efficiency and accurate control are required, prismatic and mirrored glass hold the field. The former finds its greatest application in direct lighting and the latter in indirect lighting. Each kind is designed for many types of light distribution and accomplish the objects of their designs very accurately.

It may be of interest to briefly consider the manner in which the various characteristics are evaluated. The transmission factors of globes are measured in a sphere photometer. The light output of a suitable lamp is measured without the globe in place and then again with the globe in place. The ratio of second to the first measurement shows the percentage of light that is transmitted by the globe. This also applies to any type of unit, showing the percentage light transmitted and reflected.

To determine the effect of the glassware on the distribution of light the lamp with which it would be used is placed on a distribution photometer and measurements of candle power are made at 10° positions all around the lamp in a vertical plane. A similar

series of measurements is made with the lamp equipped with its auxiliary glassware. The results are expressed as the percentage of the total lamp lumens that are directed into certain zones such as 0-60°, 0-90° and 90°-180°. From these measurements the unit's efficiency can also be calculated.

The diffusion characteristic is determined by measuring the distribution of surface brightness across the diameter of the glass and plotting the results. It can be expressed numerically as the ratio of the average to the maximum brightness or the ratio of the minimum to the maximum brightness in candle power per square inch. These figures can also be used as a rating of the unit as regards the overall brightness with respect to glare.

Each of the types of glassware mentioned herein has certain inherent characteristics that render it specially desirable for certain purposes but it cannot be said that each has its own particular field. Each selection must be based upon a careful consideration of the requirements of each case bearing in mind that the first function of the installation is to produce light for a certain purpose. Next to this the most important consideration is the limitation of glare. A style of unit should be selected that has ornamentation (if any) to harmonize with the surroundings. A further important consideration is that regarding the maintenance, as upon this feature depends to a large extent the continued success of the installation.

Electrical Rectifiers

RECTIFIERS are used to produce pulsating unidirectional currents from an alternating current supply in order to make possible the charging of small storage batteries for automobiles, radio equipment, etc., in locations where a direct current source does not exist.

The rectifiers which are on the market are of four types:

1. Mechanical, Vibrating and Rotary.
2. Thermionic Tube, two element.
3. Electrolytic.
4. Mercury Vapor Tube.

(1) *The Mechanical Vibrating Rectifier,* is essentially an electrically operated oscillating and reversing switch and consists of a small transformer to step down the line voltage and a vibrating armature which connects the battery to the transformer at the proper instants with correct polarity to insure that current flows in one and the right direction only.

The armature is caused to vibrate at the frequency of the a.c. supply, making contact and connection to the battery on one or both halves of the wave. Where the whole wave is used, the transformer has two secondary windings, connected in series, and a tap taken from this centre connection to the battery, the other wire to the battery coming from the vibrating element. One winding sup-

plies current on one-half of the a.c. cycle, the other winding supplying current on the other half cycle.

The contacts in some rectifiers are of metal, whereas the higher grade rectifiers are fitted with carbon and copper contacts which materials are not as readily burned by the sparking and therefore require less attention. The properly designed vibrator however, can be adjusted to function without much sparking, in which case the contact will serve for an indefinitely long period.

The step-down transformers are designed to give a fixed secondary induced voltage. Thus, as the battery charges up and its terminal voltage rises, the charging current is gradually reduced. This is known as the "tapering charge" and is a desirable feature in any device which is charging lead storage batteries.

This transformer also serves to insulate the battery and charging leads from the a.c. supply, making it safe to handle these while wet.

Rectifiers of this type are adjusted to automatically open the battery circuit on failure of the power supply in order to prevent the battery from discharging through the windings of the transformer. It is safe, therefore, to allow the rectifier to run without attention at night as it will not allow the battery to be charged too rapidly, nor to discharge itself.

The efficiency of a whole wave mechanical rectifier is about 55%. Commercial types are designed to charge 3 or 6 cells of storage battery at rates varying from 5-8 amperes.

(1b) *The Mechanical Rotary Rectifier* is a contacting device and is used without any transformation of voltage to charge 36 cells in series.

Full wave rectification is obtained at an efficiency of 85% or higher and the rectifier is made automatic by the addition of a centrifugal cutout and reclosing circuit breaker. The operator's attention therefore, is not required on failure of the power supply, as the circuit to the battery is immediately opened. This rectifier will start up under any condition of light or full load upon closing the supply switch or resumption of power. The device consists of a small synchronous motor, driving a rotary switch which makes contact through carbon brushes. The power supply is single phase and current is controlled by means of a resistance type current regulator.

A rectifier of this type should have a wide application, it being quite simple and requiring attention only in trimming and renewing of the contacts. It should be a very satisfactory charging device for an automobile garage, where the number of cells to be charged varies greatly. Being capable of charging from one to about forty cells at a time, the batteries could be connected in series and charged simultaneously.

(2) *The Thermionic Tube Rectifier,* of which the "Tungar" is the most common form for low voltage rectification, is also used for the charging of small storage batteries.

As in the mechanical rectifiers, a transformer is required to first reduce the a.c. supply voltage to a suitable value but instead of using a vibrating armature, rectification is accomplished by means of a two element gas filled thermionic tube having a hot filament and a cold carbon electrode.

This tube has the property of allowing current to flow through it in one direction only, namely from the cold electrode to the hot filament. The filament is heated by current from a section of the transformer winding and the supply to the battery is taken from another section of the winding adjacent to those turns which supply current to the filament. When in operation the tube is in series with the battery: current flowing in the proper direction passes through the tube with a drop of about 1 volt, irrespective of the magnitude of the current, but the reverse flow of current is prevented as the tube then becomes an almost perfect non-conductor.

When there is a failure of power, the filament cools and the tube then offers a very high impedance to the flow of current in either direction. Upon resumption of power, the filament again heats up to normal and the charging operations continue.

The valve action of the tube makes the rectifier automatic and allows safe operation without attention. Where one tube is used half wave rectification only is obtained. With a double winding on the transformer, two tubes may be used giving full wave rectification. In either case, however, the efficiency of the rectifier is only about 50% at full load. Rectifiers of this type are built to charge, 3, 6, or 36 cell batteries, at rates of 3-8 amperes.

In either half wave or full wave rectification, a series of unidirectional pulsations of current are obtained, similar to but of more smooth wave form than those given with the mechanical rectifier. It is possible, however, to use several Tungar rectifiers on transformers connected to a three phase circuit and obtain a fairly smooth direct current. The mechanical rectifiers cannot be used in this way.

The Thermionic tube rectifier and mechanical rectifier can be employed for any service where unidirectional currents are required when it is allowable to have these currents pulsating. They also may be used in certain circuits where very small steady direct currents are required as it is possible in such cases to smooth out the pulsations from a full wave rectifier by means of additional inductances and capacities. These rectifiers, however, are not satisfactory for operation of direct current machinery, where heavier steady unidirectional currents are required.

Two-element thermionic tubes are also designed for the rectification of very high voltages. The principle of operation is the same as in the Tungar rectifier but the tubes instead of being gas filled are evacuated to a very high degree. The shape of the tube is also changed in order to increase the arcing distance between terminals

(on the outside).

In this form the thermionic tube is used in smoke precipitation processes and also for radiographic work where the one tube serves the dual purpose of an X-Ray generator and a rectifier. Thus it has very greatly simplified the equipment at the same time giving more steady radiation with better definition in the radiograph.

(3) *The Electrolytic Rectifier,* one of the earlier types consists of two plates—one of aluminum, the other lead—immersed in any of several solutions. This combination acts as an electric valve, in much the same way as the thermionic tube, to allow the easy flow of current in one direction but to oppose any tendency to reversal of direction.

It is used in connection with a transformer for either half wave or full wave rectification and is connected in series with the load, the lead plate being the positive terminal.

This type of rectifier is simple and cheaply constructed and is satisfactory for handling small loads where the service is intermittent. The efficiency is usually less than 50%, the heat loss in the rectifier being fairly large and resulting in rapid deterioration of the plates. As the temperature of the plates rises, the degree of rectification becomes less complete for the leakage of reverse current increases. This type of rectifier is seldom used for ordinary steady loads. It appears to be limited to X-ray and radio equipment and also experimental work where a cheap device is required for intermittent service.

(4) *The Mercury Vapor Rectifier* is quite simple in structure, consisting of an evacuated vessel in which there is a pool of mercury connected to a terminal passing through the wall of the vessel. At the top of the vessel are two terminals of iron or graphite.

A supplementary electrode is supplied for the purpose of starting or exciting the rectifier. In some designs of mercury tube this takes the form of an extra mercury pool and the rectifier is started by tilting the tube until the edges of the two pools are brought together closing an auxiliary circuit and causing a spark, or arc, to form where the edges recede. This arc starts the vaporization of the mercury and then strikes across to the operating anodes and the rectifier continues to run normally if the proper amount of inductance is included in the circuit.

This tube is also an electric valve used in connection with a transformer and permitting current to flow in only one direction. It requires, however, that the positive terminal be kept at a certain definite potential above the mercury pool. Should the potential drop below the critical value, the current will gradually decrease to zero.

This type of rectifier has been used to a considerable extent for arc lighting and for charging storage cells. It will not start automatically and therefore requires attention whenever there is an interruption of power.

Hydro News Items

Central Ontario System

Estimates have been prepared for rural service to the Hemlock Park Dairy Farm in the vicinity of Kingston Mills.

* * *

Rates have been submitted for rural service to the district around Millbrook, including the Village of Bethany.

* * *

Niagara System

Work was commenced in August in connection with the installation of a 110,000 volt station on the site of the Toronto Power Terminal Station, Davenport and Dupont Streets. The present installation consists of two banks each of 3-5000 kv-a transformers.

* * *

Work was also commenced in September on a new outdoor type 110,000 volt station on Wiltshire Avenue south of Davenport Road. The first installation will consist of three banks each of 3-5000 kv-a transformers. Both these stations will be ready for partial service about December 1st.

* * *

Steps are being taken to have the Municipality of Thorold take over the customers and lines included in the system located in Thorold which were taken over from Mr. James Battle when his interests were purchased in 1918.

* * *

The Municipalities served from the Essex County System are being requested to take over the ownership of the distribution systems. The Essex County System was purchased from the Essex County Light & Power Company in 1918, and has since been improved and placed in a very satisfactory financial condition, and it is considered advisable that each Municipality should assume the responsibility of financing and operating its own distribution system. The transmission lines and stations will be retained as part of the Niagara System.

* * *

Rideau System

The conditions governing the storage of water on the Rideau System, coupled with the growing loads of the various municipalities, make it apparent that the limits of the present power developments have been reached. A new source of power is needed and until this is in sight any application for large blocks of power will have to be refused.

* * *

There is some hope of settlement in the lawsuit between the Town of Kemptville and the Kemptville Milling Co. The Municipality won its case recently and the Company appealed against the decision. Several meetings between the parties have

taken place and it is hoped that an amicable settlement will be reached.

* * *

Messrs. Findlay Bros., of Carleton Place, have erected a new enamelling plant for their gas and electric ranges.

* * *

The Grenville Crushed Rock Company has ceased crushing operations for this year.

* * *

Thunder Bay System

Arrangements are being perfected for extending the 110,000 volt. transmission line of the Thunder Bay System from Bare Point east of Port Arthur (the present terminus) to the site of the Great Lakes Paper Co.'s mill west of Fort William to supply energy to the company at that location. This company expects to begin operations in the Spring and will take about 10,000 h.p. Energy will be delivered to the customer's station at 110,000 volts.

* * *

The preliminary work on the second circuit of the transmission line between Cameron Falls and Port Arthur has been completed and the construction of this line will be undertaken immediately. This line will consist of a single circuit placed on steel towers designed to carry an additional circuit when required. The towers are being furnished by the Port Arthur Shipbuilding Co., of Port Arthur.

* * *

The construction of the extension to the development at Cameron's Falls is proceeding rapidly and the work will be rushed to completion so as to provide two additional generator units to take care of the increased demand brought about by the contract with the Great Lakes Paper Company, and other large power customers on the system.

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in October 1923.

Appliances

The Gurney Foundry Company, Limited, 500 King St., W., Toronto.

"Gurney" Hot Plates, Cat. Nos. 101 and 201.

* * *

The Brock Snyder Manufacturing Co., Grimsby, Ont.

Flat Irons, "La Jiffee".

* * *

Air-O-Mix Incorporated, Beech and Anchorage Sts., Wilmington, Del.

Whipping Machine, "Whip-All."

Superior Electrics Limited, Pembroke, Ont.

Electric Ranges, Cat. Nos. 463 and 464.

* * *

Mr. W. Juniper, 180 Charlotte St., Peterborough, Ont.

Portable Table Stove.

* * *

Empire Brass Mfg. Company Ltd. (Submittor), 110 Adelaide St., W., Toronto, Ont.

The Duro Pump & Mfg. Co. (Manufacturer), Dayton, Ohio.

Motor Operated Pumps & Water Systems, "Duro".

* * *

PYROGEN PRODUCTS, Weston, Ont.

"Pyrogen Constant Water Heater".

* * *

CANADIAN GENERAL ELECTRIC COMPANY, LIMITED, Hotpoint Works Division, Stratford, Ont.

Curling Irons "Hotpoint" Cat. Nos. L.4, L.8 and L.10.

* * *

CANADIAN RADIANT ELECTRIC COMPANY, Grimsby, Ont.

Electric Upright Toaster, "DE LUXE".

Electric Flat Iron, "DE LUXE".

* * *

WELLAND IRON AND BRASS COMPANY, Welland, Ont.

Refrigerator "Lektrik-Ise".

* * *

WHITTAKER STOVE WORKS, Windsor, Ont.

Air Heaters, Cat. No. 21.

* * *

CANADA INGOT IRON CO. LTD., (Submittor), Guelph, Ont.

GLADSTONE ELECTRIC LIMITED, (Manufacturer), Guelph, Ont.

Electric Ranges, Nos. 2001, 2022 and 2003.

* * *

HARRY R. REED, (Submittor), 48 Broadway Ave., Toronto, Ont.

SECURITY ELECTRIC MFG. CO. (Mfr.), 2635 Canton St., Chicago, Ill.

Curling Iron.

* * *

THE BRITISH AMERICAN WAX PAPER COMPANY, LIMITED, (Submittor), Wrigley Building, Toronto.

BATTLE CREEK BREAD WRAPPING MACHINE CO., (Mfr.), Battle Creek, Mich.

Bread Wrapping and Sealing Machine "Brownell".

* * *

THE McCLARY MANUFACTURING CO., London, Ont.

Electric Ranges, Cat. Nos. 10, 11E, 12D, 62 and 6216.

* * *

THE FITZGERALD MANUFACTURING COMPANY, Torrington, Conn.

Portable Electric Waffle Iron, "Star".

Portable Electric Air Heaters, Model B and D.

* * *

THE BROCK SNYDER MFG. CO., (Mfr.), Grimsby, Ont.

QUALITY TOOL WORKS LTD., (Submittor), Montreal, Que.

Flat Iron, "Q.T.W."

* * *

THE BROCK SNYDER MFG. CO., (Mfr.), Grimsby, Ont.

ROBT SIMPSON CO. LTD., (Submittor), Toronto.

Flat Iron "Blue Bell".

* * *

THE BROCK SNYDER MFG. CO., (Mfr.), Grimsby, Ont.

JAS. A. OGILVY LTD., (Submittor), Montreal, Que.

Flat Iron, "Everbest".

* * *

Burlington Electric Company, (Submittor), Burlington, Ont.

Canadian Radiant Electric Company, (Mfr.), Grimsby, Ont.

Electric Upright Toaster "Burlington".

Electric Flat Iron, "Burlington".

* * *

*Delco-Light Co., Dayton, Ohio.

Electric Washing Machine "Delco Light Washers".

* * *

*Dick Co.,A.B., 730-38 W. Jackson Blvd., Chicago, Ill.

Mimeograph.

* * *

International Harvester Company Of Canada, Ltd., Sherman Ave., N., and Burlington St., Hamilton, Ont.

Cream Separator "Primrose".

* * *

Fittings

The Canadian General Electric Company, Limited, 224 Wallace Ave., Toronto.

Receptacles for Attachment Plugs and Plugs, G.E. 622A.

* * *

A. C. Simmonds, (Submittor), 321 King St., E., Toronto.

N. V. Electriciteits Maatschappij Electrostoom, (Mfg), Rotterdam, Holland.

Solderless Connectors "Jasper".

* * *

Benjamin Electric Mfg. Co. Of Canada, Limited, 11-17 Charlotte St., Toronto.

Current Tap, "Benjamin".

* * *

Hunt Brass Works, 30 Holly St. Toronto.

Wire Connectors, "Safety".

* * *

A. L. Wynston, Jr., (Submittor), 77 York St., Toronto.

Fittings Limited, (Mfr.), Oshawa, Ont.

Outlet Plate with Bar "Circle W".

* * *

Hessco Electric Manufacturing Company, 65 Frederick St., Toronto.

Fuseless Attachment Plug, Cat. No. 319A, "Orpen".

* * *

Switches

*Tork Co. Inc., (Submittor), 8 West 40th. St., New York, N.Y.

Automatic Switches—Clock Operated Type, Cat. Nos. 1106, 1166, 1115, 1130, 1230.

* * *

The Devoe Electric Switch Company, 414 Notre Dame St., W., Montreal, Que.

Panelboards, Types C, D and E.

* * *

Canadian General Electric Company, Limited, 224 Wallace Ave., Toronto.

Tumbler Switches, 3 way, porcelain cover, C.G.E. 312.

* * *

The Devoe Electric Switch Company, 414 Notre Dame St., W., Montreal.

Knife Switches, Type "A", 30-2000 Amps. Type "C", 30-200 Amps.

* * *

Miscellaneous

*Live Wire Co., The, Ltd., Guelph, Ont.

Rubber-covered Wire.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

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CONTENTS

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Plant Growth Stimulated by Electric Light

We publish in this issue a very interesting photograph of two geranium plants; one grown in daylight, the other by electric light, shewing remarkable development of the latter as compared with the former. That a great deal of the wonderful growth of the plant reared under artificial conditions may be attributed to the light cannot be disputed but the comparison would have been better had the room temperatures been the same in each case, as under the actual conditions of the test it is impossible to say just how much of the growth of the larger plant was due to light and how much to a higher temperaure. The relative humidities of the two rooms also may have had some bearing on the results obtained.

A good deal of interesting work has already been done in the United States in growing or forcing plants by electric light and the results so far obtained indicate that florists in particular may benefit considerably by a judicious application of this method which can, apparently, enable flowers to be produced ahead of or even entirely out of season.

To what extent this application of electricity may be commercially feasible is at present problematical but that is no reason why research work along this line should not be prosecuted and we welcome this remarkable first attempt of the Commission's laboratories in the hope that it may stimulate others to take up this interesting work.

Public Ownership in Great Britain and The British Empire

Address by Hon. A. Emil Davies of the London County Council at the Public Ownership Conference at Toronto, Ontario, September 10th. to 13th., 1923

The following is a resume of Mr. Davies' address and is a part of one of thirty-five delivered at the above conference. Readers desiring the full stenographic report of this or of the other addresses may secure them by addressing the Public Ownership League at 127 N. Dearborn Street, Chicago.—The Editor.

LET me express my gratification and pleasure at being permitted to address you and bring you greetings from those holding similar views in England. While it might be considered in ordinary circumstances presumptuous for one coming from so small a country to tell you about things, we flatter ourselves that in addition to our own particular problems we are still nominally the centre of an Empire and therefore in a position to get a good bird's eye view of what is taking place in that Empire, and it was thought that it would interest members of the Public Ownership League of America, as American papers are not always most fully informed regarding things in the British Empire, so I was invited to address you.

Public Ownership Increasing in England.

The idea and the practice of public ownership in England is on the increase, much more so than people outside are permitted to know because just as in the United States you have a powerful Press controlled by vested interests determined to impede the growth of public ownership, the same condition exists in England. This is what is happening all the time; some social problem attains such proportions that it becomes a public scandal, something has to be done so the Government appoints a Committee or Commission. It takes evidence, investigates the problem, for the greater part of it is composed of men identified with what we call the majority interests, men who are opposed to public ownership themselves, but not one of those Commissions or Committees issues a report without being compelled to recommend either public ownership or a decided step in that direction.

To mention five matters that have been the subject of investigation by these Committees within the last two years, we have had (1) coal, (2) electricity, (3) insurance, (4) banking and (5) markets. All these have come before Commissions or Committees and in every case the report has either been compelled to recommend public ownership or to advise something approaching it.

I will mention one instance. Our markets in London are disgraceful. We had a Committee consisting of members of the House of Lords, members representing the vested interests and about two people whom you might term radical and here is the unanimous recommendation of that Committee regarding London's greatest market: "We wish to record our opinion in the strongest possible terms that this market, the largest of its kind in the Kingdom, should be placed under public Authority with a view to its development in the interests of the trade and the consumer."

The English Idea of Public Ownership.

Now a word about English ideas as to public ownership. Every intelligent man and woman in England, we have quite a few hundred of them, agrees that there are some industries, and services which should not be in the domain of private enterprise animated with the purpose of making private profit.

We have in our country a few private roads left, there are in England 102 toll gates still, a reminder of the happy days of private enterprise, we have one within four miles of the centre of London. Every vehicle passing through has to pay so much and get a ticket, which does not cause many accidents through excessive speed at those points. We had a meeting the other day in England of the Association of Commercial Automobile Users asking the Government to remove these toll gates, in other words to take these private enterprise roads out of the control of private interests.

There are in the world cities whose drains are actually owned by English companies—Valparaiso for example. If you think there are some things that do not belong in the realm of private profit-making you are wrong, you can make profits out of anything if you charge enough, and these drainage companies pay good dividends so that instead of the sewers being a drain on the profits they represent a profit on the drains.

Most Advanced Municipalities in the World.

Whatever is in universal use or necessary to all sections of the community is ripe for public ownership.

I do not believe we shall ever see the day, I do not wish to see it when everything is nationalized, but I want to see all the vital and public utilities municipally or corporately owned. There is no line of demarcation at all, one thing leads to another. The City of Glasgow has the most successful street tramway system in the world. From that Glasgow developed into building its own street cars, and it makes the best street cars made in the British Empire. The Glasgow Tramway system is also unique in another respect, it is through with its sinking fund, has actually paid off the entire capital invested. That is to say the book value of the capital expended on the Glasgow municipal tramway is $20,000,000. Every cent of that amount has been paid off. Freedom not only from the annual interest requirements but the heavy sinking fund charges is a very substantial relief. I believe we are more advanced in point of time than any other municipalities

in the world, I can assure you that within the next ten years you will have in Great Britain a magnificent series of examples of municipalities which have paid off the entire debt standing against their gas works, their water works, and in some cases their electrical undertakings, and a better object lesson to the inhabitants of a city than finding themselves suddenly released from an annual burden of let us say half a million or one million dollars would be hard to find.

As a matter of fact the whole march of civilization is coincident with the birth of public ownership.

How the Public Fire Department Came.

To this day if you go through the country districts of England you will often see on an old house a little plate and on that plate a word, it may be Phoenix or Royal or Consolidated, what is the origin of that? In the early days of fire insurance companies there were no publicly owned fire brigades, each fire insurance company had its own brigade, and if you had a fire you would send a special messenger, perhaps on a horse, to the fire brigade belonging to that company. The Phoenix fire brigade would come along in course of time and if they saw a house burning they would look at the plate and say "This is not a Phoenix fire, this is a Royal fire", so they would go on a little bit and see if by any chance there happened to a Phoenix fire, and if not they would turn around and help extinguish the Royal fire if there was one left, and then send in a bill to the Royal Insurance Company demanding payment.

London the Biggest Landlord on Earth.

Housing conditions in England are awful and private enterprises in housing has completely broken down because it does not pay to buy or build a house for renting. So the L.C.C. had to tackle housing. The result is that there is now in actual progress a scheme devised by the Government and by a municipal body, the biggest in the world, wholly opposed to public ownership, which will result in the municipality of London being the biggest landlord on the face of the earth.

In England no one dreams of starting a new tramway, omnibus, electric or gas company, they know that the public would not stand for it, it is understood that all such new ventures should be publicly owned, and not a year passes without a score or so of the existing ones being purchased by the municipalities.

Municipal Insurance and Banks.

We have developed municipal insurance funds very largely. We pay into our fund just the same rate of premium as paid to the insurance companies, and our accumulated insurance fund has reached such gigantic proportions, that we are strictly under the seal of secrecy in the Finance Committee not to reveal what that fund is. But I think the most significant development of public ownership in England in the last ten years is in the shape of the Birmingham Municipal Bank. It was opened two and a half years ago and was the first to be started in Britain. The bank has become so popular that within two and

a half years its deposits amounted to $15,000,000 and it takes deposits of two cents and upward.

OTHER GOVERNMENT ENTERPRISES.

Then we have an Imperial cable. If you go to the British Post Office you will see notices imploring you to send your cablegrams "via Imperial."

It also has on the postmarks "Send your cables via Imperial", and the President of one of the cable companies got up and wept bitter tears "That we who are taxpayers should be obliged to have our letters that we send to our customers stamped with a request to send their cables by the government lines."

In London you have merely to look around our streets and you will see everywhere Stateowned shops, they generally have them over the name of the Government of New Zealand, Dominion of Canada, Union of South Africa, Ontario has a shop showing wonderful apples such as I have not seen here. Some time ago I saw a man painting out the words "Grand Trunk Railway" and putting over them "Canadian National Railways". That sort of thing is going on all the time. It is not only the British Empire, you will see Italian, French, Swiss State Railways, all through London you will see excellent shops with magnificent displays which are Government shops.

In New Zealand they have all sorts of things Government owned. They have an Insurance Department which does every sort of insurance and officially states that it has brought down the premiums charged by the old companies 33 per cent. You have in Queensland a State insurance office, having a building like this as its head office, which has 700 agencies up and down the country, which has brought down rates enormously and has paid handsomely and given bonuses to the policy holders. The Commonwealth Bank of Australia has branches throughout the Country and is making a profit of $4,000,000 a year.

The Work of the Public Ownership League and Progress of Public Ownership in the United States and Canada

By Carl D. Thompson, Secretary of the Public Ownership League of America

Extracts From Address at the Public Ownership Conference at Toronto, September 10th. to 13th., 1923

THE Public Ownership League of America was organized June 1, 1916.

It is now a permanent American Institution with a regular and affiliated membership of nearly ten thousand, in all sections of the United States and Canada.

The Information Department of the League is accumulating, classifying and making ready for service the facts and information on publicly owned utilities—a service that grows in value as well as volume as the years go by.

The League has published 25 different bulletins on different phases of public utility problems and has 7 more in preparation.

Municipal Ownership

Over 750 cities have established the public ownership of electric light and power plants since the League began its work and over 50 of these have sought and used the League's service in taking over their plants.

So far the League has never lost a campaign in which its methods and management have been accepted.

Leaflets, Bulletins, Magazine

It has published and distributed over a hundred thousand bulletins, booklets and leaflets and over a million pieces of literature.

The League began the publication of a regular monthly magazine in February of the year, 1922.

The literature of the League is now in over 1,725 public libraries of the United States.

Superpower

The next great development in the utility field and the one that is almost certain to revolutionize the whole industrial, domestic and agricultural processes of the world is hydro-electric and super-power, in the vanguard from the beginning.

Sir Adam Beck, Chairman of the great publicly owned Hydro-Electric Power Commission of Ontario has blazoned the way, while other notable members of the League in California, Georgia, South Dakota, Minnesota, Illinois, Iowa, Nebraska, Washington, Oregon, Michigan, and elsewhere are awakening the people of their respective states to the tremendous possibilities of public ownership in hydro-electric and super power development. In this respect the League is launching the greatest reconstructive movement of modern times. And the work is just beginning.

Annual Reports

At the beginning of each year the League published an annual report of its activities, receipts, expenditures, etc., which is mailed to every member and affiliated body. It will not be necessary, therefore, to go into detail in these matters at this time. It will be sufficient to mention and emphasize the more important features of the work.

Brief Resume of Year's Work

The following are a few of the activities of the League for the year 1922:—

1. Published a monthly magazine.
2. Conducted an Information Service answering over 2,000 inquiries during the year.
3. Conducted campaigns for the municipal ownership of electric light and power plants in Muscatine, Ia., Clifton Forge, Va., and Kewanee, Ill., devoting from two to three weeks' time to each campaign, AND WON IN EVERY CASE.
4. Assisted fifty additional cities, in matters requiring the information and service of utility experts, legal or engineering advice with relation to their utility problems.
5. Supplied data on state owned

hydro-electric and superpower for the California state campaign.

6. Prepared data on public ownership for 300 newspapers in South Dakota for seven successive weeks.
7. Devoted six weeks to a campaign against a vicious state constitution in Illinois, AND WON—the measure being defeated by a vote of 5 to 1.
8. Assisted the debating teams in 44 schools, colleges, and universities with information on public ownership debates as follows:— Nationalization of coal mines, 16; Public Ownership of Railways, 4; of street car lines, 6; Municipal Ownership, general, 3; Public Ownership, general, 16.
9. Supplied all members of the legislature of Minnesota with bulletins on Superpower and public ownership preparatory to launching a state wide movement in that state.
10. Prepared bulletins to go to 1,000 selected names in North Carolina on hydro development.
11. The secretary made several short lecture trips for the Plumb Plan league
12. Bulletins on Municipal Electric Light and Power Plants supplied to all members of the state legislature of Oklahoma.
13. Published five new Public Ownership bulletins. The League now has 25 regular bulletins on different phases of public ownership.
14. Helped the city of Maquoketa, Ia., with legal and engineering advice that enabled it to overcome an injunction and other obstacles and develop its municipal light plant.
15. The secretary delivered over 200 lectures in different parts of the country on various phases of public ownership—notably at the meeting of the Nebraska League of Municipalities at Lincoln; the Illinois State Federation of Labor Convention at Rockford; the St. Louis, Mo., Open Forum; the Terre Haute, Ind., Open Forum, etc.
16. Conducted a weekly Public Ownership Lunch Club thruout the year, in Chicago, at which many prominent speakers from different parts of the country were heard on many different phases of public ownership.
17. The Secretary made a trip to the extreme western part of Colorado for the Railway Brotherhoods to present their case against the reduction of wages at a great conference of farmers, business men, railroad workers and miners of all the "western slope."
18. Worked with the League of Municipalities of New Jersey in supporting their measure in Congress protecting the home rule of cities.
19. Supplied information on municipal ownership to the Commission of the city of Boston, Mass., while it was in Chicago, and since.
20. Prepared a bulletin giving the history, the facts, and information relative to state owned banks for South Dakota.

21. Aided in the campaign in California to prevent the emasculation of the Initiative and Referendum law. The measure was defeated.

22. Secured notable accessions to our membership during the year. Among these were the municipalities of Springfield, Ill., Maquoketa, Ia. Muscatine, Ia., and Clifton Forge, Va.; the public libraries of some 15 different cities; the International Association of Window Glass Workers; some 8 or 10 Central Labor bodies and numerous local organizations in different cities, beside many noted individuals.

Later Activities.

Besides the above, mention should be made of a few activities of the League since the above resume was published:—

We helped to defeat the proposed amendment to the Federal Constitution for the taxation of public securities; the Secretary attended and took part in the Santa Barbara (Calif.) conference in behalf of hydro-electric development for the seven states of the south-west; toured the States of California, Oregon and Washington, stimulating public ownership and superpower; started the public superpower movement in Wisconsin and Minnesota, and, incidentally, on the way back from a western trip, took part in the campaign that elected Magnus Johnson to the United States Senate.

Plans for the Next Two Years.

So much for the work done. May I now outline what we hope to do in the next two years:—

1. We want to enlarge and increase the circulation of our monthly magazine "Public Ownership." If we can bring the circulation up to 5,000 we can begin to get advertising and put it on a paying basis and make it a financial success as well as a moral and intellectual force.

2. Publish the proceedings of this conference. That will cost about $1,000—but it must be done.

3. Conduct or help in superpower campaigns, particularly in the States of Washington, Oregon, Michigan and Minnesota. In Washington and Oregon the matter will go to general referendum vote during the year.

4. We must help the people of the Southwest in their Boulder Canon hydro-electric project.

5. We want to formulate, have introduced in Congress and promote a federal law providing for a United States Superpower Commission to function in the United States as the Hydro-Electric Power Commission functions in Ontario.

6. We want to develop a service of information to municipalities to help in their efforts in connection with public utility projects.

7. We want to unify and co-ordinate the municipal and public ownership movements and especially those now arising in various sections of the United States and Canada for public hydro-electric

and superpower, in order that they may become more effective and successful.

Appeal for Help and Co-operation.

All these things we should do. And yet, so far, our numbers and financial resources are comparatively meager.

For example, the organization that is doing for the private utility corporations what the Public Ownership League is doing for the municipalities of America, has a budget of $200,000 a year. Against that we go out to battle with less than $9.000 a year. It is an unequal battle. But I submit to you that so far we have fought a good fight.

Do you want this work to go on? Is it worth while? If so then we appeal to you to join hands with us, put a shoulder to the wheel and help to put the League upon a financial basis that will make it possible to do the work with increasing effectiveness and success in the future.

First World Power Conference

Mr. F. W. Field, H.M. Trade Commissioner Department of Overseas Trade at Toronto reports the following regarding the First World Power Conference to be held in England during the coming summer.

The programme of the First World Power Conference to be held at Wembley from June 30th. to July 12th., 1924, is now available. The conference is promoted by the Council of the British and Allied Manufacturers' Association in co-operation with the various technical and scientific institutions and industrial organizations, throughout the world and will be under the presidency of the Earl of Derby. National Committees have been formed representing Great Britain, Australia, Canada, India, America, Austria, Belgium, France, Denmark, Czecho-Slovakia, Greece, Holland, Italy, Norway, Roumania, and Sweden. The programme has been arranged in five divisions, under the general headings of:—

1. *Power Resources,* in which consideration will be given to a survey of developed and undeveloped national power resources.

2. *Power Production,* governing water, preparation of fuels, steam power production, internal combustion engines, and power from other sources.

3. *Power Transmission and Distribution.*

4. *Power Utilisation,* for industry and domestic use, in electro-chemistry and electro-metallurgy, for transport, for illumination.

5. *General,* comprising a number of subjects that do not readily lend themselves to classification in the previous divisions.

The names of many eminent scientists, engineers, and power specialists figure in the list of authors of papers to be submitted.

Future Sources of Power Supply

Report of Address by Sir Adam Beck at Ontario Municipal Electric Association Meeting at Toronto

THE express advisability of taking immediate steps to overcome the power shortage in Ontario by the installation of steam plants at strategic points throughout the Province was urged by Sir Adam Beck in his address before several hundred delegates at the meeting of the Ontario Municipal Hydro-Electric Association, held in the City Council chamber yesterday afternoon (November 14, 1923).

"I have good news for you to-day," he declared. "For months my engineering staff, supplemented by the best expert advice obtainable, have been working out the question of steam plants. My message to-day is this: By the proper location of steam plants, with respect to loads and economy in operation, it is anticipated that it will not affect the rates to consumers to any great extent over that necessary at the present time, until the ratio of steam plant capacity to total capacity is in excess of 40 percent.

With the necessary permission from the Government, Sir Adam declared, he would be ready to proceed as soon as possible with the installation of a large steam unit in Toronto, costing probably between $8,000,000 and $9,-000,000, with an immediate capacity of approximately 100,000 h.p., and capable of extension to 300,000 h.p. This would release at once a similar amount for other municipalities.

"There is nothing for the East that I can see, unless we undertake some development on the St. Lawrence River, or establish a steam unit at, say Cobourg with probably 50,000 h.p.," he continued.

With these auxiliary units supplying 40 per cent. of the total power output and the available development, including the St. Lawrence finally realized, Ontario would have, in 30 or 40 years' time, 4,500,000 h.p., or even 5,000,000.

Once the St. Lawrence scheme was accomplished, he said, it would be a simple matter to consolidate several of the present systems, reducing the 12 now existent to five.

"We are not asking much of the Federal Government in the development of power on the St. Lawrence," said Sir Adam. All that was asked was the payment of one-fifth of the cost of the control dam at Morrisburg, which would regulate the levels of Lake Ontario.

Interference and persecution by the Drury Government had cost the municipalities of Ontario approximately $5,000,000, Sir Adam alleged, but this was a small matter when compared with the effect of such a policy in retarding the uses of electricity and in making no adequate provision for increased demand.

One of the many serious difficulties facing the country at the present time was the diversion of a large quantity

of water at Chicago by the Sanitary Commission of that city, thereby "defying the law, defying public sentiment in both countries, and deliberately and improperly and immorally diverting water that affects the health and prosperity of millions of people in a foreign country." Sir Adam stated that on the best of authority he had been informed that the Solicitor-General of the Federal Government of the United States intended taking legal action against the Chicago Commission for its action.

"But until we have got real objection from the Dominion Government, our own Federal authorities, the United States Solicitor-General would be almost powerless to prevent such diversion. The Chicago Drainage Canal had a capacity of 14,000 to 16,000 second feet—an enormous body of water—almost double the quantity of water passing down the Ottawa River.

Sir Adam cited figures showing the rapid increase in power consumption in the past decade. In the last two years there had been an increase of 207,000 h.p., in 1913 the figure stood at 45,402 h.p., in 1923, 625,000 h.p. This increase had taken place in a period of marked depression. What would happen, he asked, once new industries began operating?

Referring to the delegation from Oshawa to the Commission the previous day, Sir Adam declared it was the first time that a group of manufacturers had recognized or approached the Commission for assistance.

"Financially, we are taking care of all our investments," he said. There was sufficient revenue to take care of operation, maintenance, all interest charges, including the whole of the cost of the Chippawa canal.

By December it was hoped to have another generator, making six. Two more had been ordered, bringing the total up to eight. This, it appeared, was the limit, as there was not sufficient water for further additions.

—The Globe.

Chronology of the Incandescent Lamp

By Henry Schroeder, General Electric Company

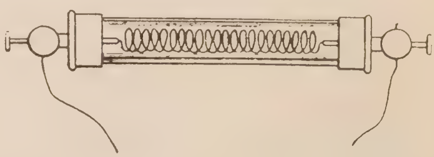
IN 1802, Sir Humphry Davy gave a lecture before the Royal Society in London, an association of scientists, demonstrating that electric current could heat strips of metals to such high temperatures that they could be fused. Most metals rapidly oxidized, literally burned up, but platinum, if operated at a temperature just below its melting point, would remain incandescent for some time without oxidizing. This was the first demonstration that light could be obtained by incandescence through the heating effect of electric current.

Two years previously, Volta had announced his discovery to the Royal Society that electricity could be obtained by chemical means. He made his historic Voltaic Pile, consisting of a column of silver and zinc disks with cloths wet with salt water, between them. This forerunner of the primary battery had been improved by the use of copper and zinc electrodes in dilute sulphuric acid and Davy had made a battery of a great many cells with which he had been experimenting.

The first attempt at making an actual incandescent lamp was by De la Rue in 1820. This consisted of a coil of platinum wire in a glass tube whose ends were covered with brass caps and from which the air could be exhausted. This was probably done because draughts of air would readily cool the incandescent platinum, but it is not clear just how it was accomplished.

The Dynamo.

In 1831, Michael Faraday discovered that electricity could be generated by moving a wire in the neighborhood of a magnet. He demonstrated his historic disk machine before the Royal Society, but being interested only in pure research work, he did not develop his invention any further. Others followed this up but it was not until about 1871 that the dynamo was made commercial. The primary battery was practically the only source of electricity for about thirty years during which time several inventors improved it. During this period, although the dynamo was but a laboratory toy, it was, however, being developed, notably by Wheatstone, who patented the use of electro magnet fields in 1845; Pulvermacher, who, in 1849, proposed the use of thin plates of iron in the revolving bobbins (they could hardly be called the armature) to reduce the eddy currents; Siemens, who invented the shuttle armature in 1856; and Wheatstone, who made the first self excited machine in 1866 by use of the residual magnetism. This latter development was almost simultaneously discovered by Siemens.



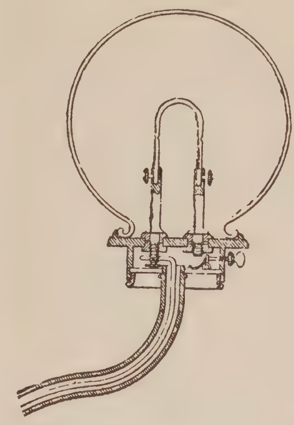
De la Rue's Lamp, 1820

It remained, however, for Gramme, in 1871, to make the dynamo commercial with his rediscovery of the ring armature. The next year, Alteneck invented the drum wound armature.

EARLY LAMP DEVELOPMENTS.

In 1840, Sir William Robert Grove improved the primary battery by using a platinum electrode in strong nitric acid within a porous cup set in dilute sulphuric acid. Zinc was the other electrode which was placed in the sulphuric acid. This combination made a very powerful battery, having nearly double the voltage of previous batteries. He demonstrated his battery betore the Royal Society, incidentally heating a number of coils of platinum wire which he covered with glass tumblers to protect them from draughts. These could hardly be called lamps, but he put a number of them about the auditorium and lighted the place with them.

Frederick De Moleyns has the honor of having obtained the first patent (British) on an incandescent lamp. In 1841 he made a novel arrangement consisting of a spherical glass globe in the upper part of which was a glass tube, open at the bottom, containing powdered charcoal. Through this tube ran a platinum wire ending in a coil inside the globe. Another platinum wire extended upward from the bottom of the globe also ending in a coil which did not quite touch the other coil. The powdered charcoal was supposed to fill the two coils and bridge the gap between, the air having been exhausted from the globe. Current passing through the platinum wires and the charcoal is supposed to have heated them and so give light.

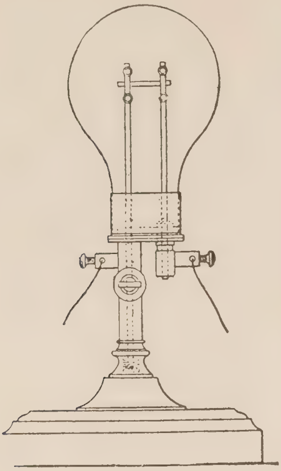


Staite's Incandescent Lamp, 1848

In 1845, J. W. Starr, a young American inventor, assisted by Peabody, the philanthropist, went to England and obtained a British patent on the lamps he had invented. One had a platinum strip whose length could be adjusted to fit the strength of battery used. The other consisted of a rod of carbon operating in the vacuum above a column of mercury as in a barometer.

During the next few years several inventors attempted making incandescent lamps, but none of them were practical as they lasted but a short time, were very inefficient and the cost of current, then practically exclusively obtained from primary batteries was so great as to make its use prohibitive. The more prominent inventors were Staite, who, in 1848, made a lamp using a platinumiridium burner covered by a glass globe but operating in air, and Roberts, who made a lamp having a graphite rod in a glass globe whose end was covered by a brass cap and from which the air had been exhausted.

In 1859, Professor Moses G.

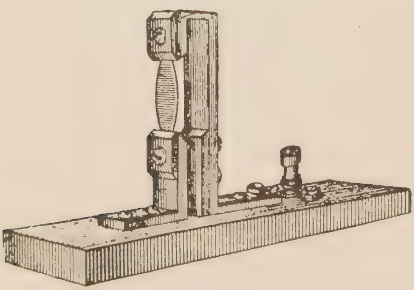


Roberts' Incandescent Lamp, 1852

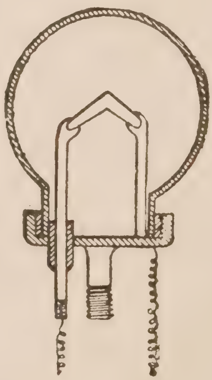
Farmer, of the Naval Training Station, at Newport, R.I., lighted the parlor of his home at Salem, Mass., in July of that year with strips of platinum operating in air. The interesting feature of these "lamps" was that the platinum strip was narrowed at its terminals to increase the resistance of these points so that the strip was uniformly incandescent throughout its entire length. The terminals conduct heat away from the burner tending to lower the temperature of the platinum which was offset by the greater resistance at these points. Prof. Farmer obtained a U.S. patent on this principle many years later (1882).

During the early seventies, several Russian scientists made lamps. Lodyguine, in 1872, made one consisting of a "V" shaped piece of graphite operating in nitrogen gas. He lighted the Navy dockyard at St. Petersburg with two hundred of these lamps and the Russian Academy of Sciences awarded him a prize of fifty thousand rubles, then worth about $25,000, for this invention. A company was formed to exploit his lamp but it soon failed.

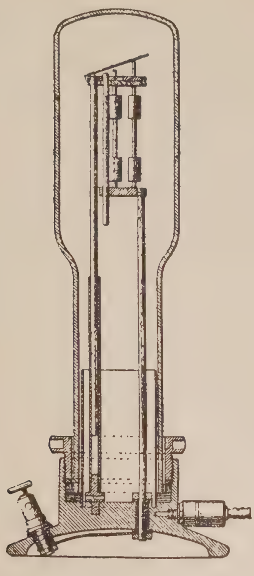
Kosloff, in 1875 made a lamp having several graphite rods for burners which operated in nitrogen gas. They were so arranged that one rod operated at a time and when it burned out, another was automatically put in circuit. The same year, Konn made a similar lamp but the graphite rods operated in vacuum. The next year, Bouliguine made a lamp consisting of a long graphite rod, only the upper part of which was in circuit. As this part burned out, the rod was automatically shoved up, a fresh portion thereby being put in circuit. It operated in vacuum.



Farmer's Lamp, 1859



Lodyguine's Incandescent Lamp, 1872



Konn's Lamp, 1875

The Arc Lamp.

During all this period the arc lamp was being gradually developed. The beginning of its general commercial use may be said to have been made by Jablochkoff, who, in 1876, lighted several boulevards in Paris with his "Electric Candle", an arc light consisting of two carbon rods held together side by side but insulated from each other by kaolin. In this country there were several pioneer arc light systems, notably those of William Wallace, of Ansonia, Conn., who became associated with Prof. Farmer; Charles F. Brush, of Cleveland, Ohio; Edward Weston, of Newark, N.J., and Ehihu Thomson, who became associated with Edwin J. Houston.

The Incandescent Lamp.

In 1878 the extensive use of the arc lamp created a demand for an electric light of smaller size. In this country several inventors were attacking this problem, among which were William E. Sawyer, Prof. Farmer, Hiram S. Maxim and Thomas A. Edison. Both Sawyer and Farmer made lamps having a graphite burner operating in nitrogen gas, and Maxim made a sheet platinum lamp and another consisting of a graphite rod operating in a rarefied hydrocarbon vapor.

Edison had a well equipped laboratory at Menlo Park, N.J., where he had several assistants and many workmen, about a hundred people all told. He had made many inventions among which was the quadruplex telegraph, the carbon telephone transmitter and the phonograph, all of which are in use at this day.

Edison first made many experiments to confirm the failure of others. This work began in the spring of 1878, and owing to the seeming impracticability of carbon for a light giving element, he decided to try platinum. Finding that it had to be operated close to its melting temperature, he designed a thermostatic regulator to automatically short circuit the burner when it became too hot. He found that continued heating and cooling drove gases out of the platinum so that it became extremely hard and could be operated at much higher temperature so that it could give more light. He also made several other experimental lamps.

Realizing that the series system of distribution was impractical for household lighting where each lamp must be independent of every other, he tackled the problem of making a completely new system patterned after gas lighting. He finally evolved a practical

multiple system. Reasoning that a high resistance lamp would be necessary on such a system, he made a platinum lamp having a long coil of fine wire mounted on pipe clay. This he put in a one piece all glass globe which he considered necessary to maintain the high degree of vacuum then available by the Geissler and Sprengel mercury pumps that had recently been invented.

The object of the high vacuum was an endeavor to drive off further gases occluded in the platinum wire so that it could perhaps be operated at even higher temperatures. This lamp, however, was very expensive to construct and to renew. He then made the bold attempt at making such a lamp with a thin carbon "filament", as he later called it, with the idea that, if successful, it would be so cheap that it could be thrown away when it burned out.

After several trials, he finally mounted a carbonized piece of ordinary sewing thread in his all glass globe, and turned the current gradually on. This was Oct. 21, 1879, and the lamp burned continuously for about forty-five hours before it failed. He applied for a patent, and on Jan. 25, 1880, a basic incandescent lamp patent was granted him. All incandescent lamps made to-day embody the basic features of his patent.

During the next three months everything conceivable was carbonized to make a better filament, carbonized paper giving results that justified him in announcing his invention. This appeared in a full page article in the New York Herald of Dec. 21, 1879. A demonstration of his complete lighting system was made at Menlo Park during the Christmas holidays by lighting the grounds and nearby country roads with lamps on poles. The crowds that came out were so great that the Pennsylvania Railroad had to run special trains. Announcement of his invention almost created a panic in the market for gas stocks. Many scientists foolishly proclaimed his invention to be impossible before they saw the actual demonstration.

Introduction of the Incandescent Lamp.

The first commercial installation of the Edison lamp was on the steamship Columbia, which started May 2, 1880, on a trip round the horn to San Francisco. Arriving there in July, the installation was deemed entirely successful in its operation during the trip. By this time, the carbonized bamboo filament had been developed, which made the lamp more sturdy. Several other commercial installations were made during the next two years but Edison believed that the most important work was the development of central lighting stations. The first one was the Edison Electric Illuminating Company, of New York, now the New York Edison Company, which started the Pearl Street Station on Sept. 4, 1882, with a load of about 400 lamps supplying some 85 buildings wired for over two thousand lamps.

The first commercial lamp really had no base; the two leading-in wires were simply soldered to strips of copper fastened to the neck of the bulb by string. A socket was made which consisted of a hollow piece of wood with two strips of copper and a thumb

screw, the latter holding the lamp tight in the socket. A base was soon developed, consisting of a screw shell and ring for terminals with wood for insulation, fastened to the bulb with plaster of paris. This was a very bulky affair, which was later changed to a cone shape ring and screw shell. This was again changed early in 1881 to the present form of base, as the previous base, with plaster of paris used for insulation, was apt to pull apart when the lamp was firmly screwed in the socket.

The first commercial lamps were made for 16 candlepower and had an efficiency of "eight lamps per horsepower". The term "watts" had not come into use at this time. Their maintenance of candlepower during their life was poor compared with the modern lamp, giving an average efficiency throughout life of a little over one lumen per watt. Their price was one dollar each. In 1881, lamps were made ten per horsepower for use on circuits where the voltage regulation was good.

Soon after Edison had commercially established his incandescent lamp, many concerns started manufacturing lamps in competition with him. Nearly each of these manufacturers had its own form of base. There were fourteen kinds of different bases made, some of which disappeared from use. Of the total lamps made in 1900, about 70 per cent. had the Edison base, 15 per cent. the Westinghouse base, 10 per cent. the Thomson-Houston base, and 5 per cent the remaining bases. A campaign was then started to standardize the Edison base, adapters being sold at cost for Westinghouse and T-H sockets, so that the Edison base lamps could be used. In a few years the desired results were obtained.

During the first ten years, the lamp was considerably improved, mainly through experience gained in manufacture. Two Englishmen, Wynne and Powell, invented the cellulose filament, which about 1894 had generally superseded the bamboo filament. This filament was "treated" that is, coated with graphitic carbon by a process invented by Sawyer, the man who had attempted making a practical lamp in 1878. Since the general adoption of the treated cellulose filament in 1894, there has been but little improvement in the carbon lamp except for Dr. Whitney's metallized-carbon or Gem lamp. The carbon lamp now has a mean efficiency throughout life of about 2-¾ lumens per watt.

The Gem Lamp.

Dr. Willis R. Whitney, head of the Research Laboratories of the General Electric Company at Schenectady, had developed an electric resistance furnace. This consisted of a tube of carbon inside of which articles to be heated could be placed. The tube was packed in sand, a heavy current heating it to a high temperature. Among his experiments he heated some carbon filaments to a temperature much higher than that attained in the ordinary oil burning carbonizing furnace. He found that the resistance characteristic of the filaments was changed making it similar to that of metals, that is, the resistance of the filaments increased with increases in temperature, whereas the reverse occurred with the regular filament. Ultimately he was able to

produce a lamp whose filament could be operated at a much higher temperature and which blackened somewhat less during its life, so that the lamp gave a mean efficiency throughout life of about 3-½ lumens per watt.

This was called the Gem lamp and was put on the market in 1905. Many millions of these lamps were sold before they disappeared from use in 1918. They were originally made with two hair pin filaments in series and in 1909 the filament was made in one piece a single oval, the same in appearance as the regular carbon lamp.

The Osmium Lamp.

Dr. Auer von Welsbach, who had produced the gas mantle bearing his name, invented a lamp having a filament of the metal osmium. It was commercially introduced in Europe in 1905, but as osmium is such a rare and expensive metal, costing more than platinum, it was impractical to manufacture it on a large scale. It quickly disappeared from use, even in Europe, largely due to the tungsten lamp which appeared soon after. The osmium lamp was only made for low voltages, to burn two or more in series on 110 volt circuits, and had an average efficiency throughout life of about 5 lumens per watt. It was not marketed in this country.

The Tantalum Lamp.

Von Bolton, in investigating various materials for filaments, produced the tantalum lamp which was put on the market in this country in 1906. Tantalum is a metal that had been known to science for about a century. He finally obtained some of the pure metal and found it to be ductile so that it could be drawn out into a wire. It has a low specific resistance so the filament had to be much longer and thinner than the carbon filament.

It had a good maintenance of candlepower during its life, having a mean average efficiency of about 4-½ lumens per watt. The life on alternating current was considerably shorter than on direct current due to more rapid crystallization of the filament. It disappeared from use in 1913.

The Tungsten Filament Lamp.

In 1902, two Austrians, Just and Hanaman, were chemical laboratory assistants in the Technical High School in Vienna. Just was utilizing his spare time by also working in another laboratory trying to make a lamp with boron for the filament. In the summer of that year he got Hanaman to assist him and together they conceived the idea of making a tungsten filament lamp. They worked for two years on both lamps, but the boron lamp was a failure.

Tungsten had been known for many years and was mainly used in steel as an alloy which made the steel extremely hard. The properties of the pure metal were not well known. Drs. Just and Hanaman found it to be extremely hard and brittle, very heavy—nearly twice as heavy as lead—and to have an extremely high fusing point. Its melting temperature is now known to be about 3350 deg. C., a temperature at which asbestos and fire brick would melt like wax.. It was impossible to draw it into a wire, so they adopted roundabout methods of making a filament.

One method was to deposit tungsten on a carbonaceous core; another was by making a paste of tungsten powder and a carbonaceous material and squirting the paste into a thread through a hole drilled in a diamond. After many experiments and failures they finally succeeded in producing tungsten filaments free from carbon. They induced a Hungarian lamp manufacturer to try these filaments commercially which were soon found to be a striking success as they could be operated at an efficiency about three times that of the carbon lamp.

A patent was applied for in this country in July, 1906. Its issue was delayed owing to the interference of three other parties, each also claiming to be the inventor. After prolonged hearings in the Patent Office, the application of one party for his patent having found to be fraudulent, the patent was finally issued to Just and Hanaman in February, 1912.

The lamps were put on the American market about the beginning of the year 1907, the first lamp being the 100 watt size for 110 volt circuits. Later as it became commercially feasible to make thinner filaments, 60, 40 and 25 watt lamps were sold. Series lamps for street lighting circuits from 40 to 250 candlepower were made, tungsten flashlight lamps gave a tremendous boost to the flashlight business as the lighting capacity of the batteries was thereby tripled, high wattage lamps up to 500 watts were soon developed for commercial lighting, etc.

Drawn Tungsten Wire.

Many scientists had tried to produce ductile tungsten and about 1906, when the Research Laboratories at Schenectady, began its experiments the consensus of opinion was that it was impossible.

The Laboratories' first discovery was that if tungsten is prepared in a particular way it could be hammered at certain high temperatures, which elongated it and changed its form. This was something no one else had done. At this time a circumstance led to the invention of the amalgam filament process, a modification and improvement of that of Just and Hanaman.

Later, however, research work was resumed in the endeavor to find a way to make tungsten ductile. A remarkable and important discovery was made that under proper conditions of working, the crystals of the metal tungsten were drawn out into fibers and in that state the tungsten filament was no longer brittle, but ductile. This is exactly the opposite of what would be expected from the knowledge of ordinary metals. The first success was obtained by repeatedly drawing a tungsten filament under careful heat conditions through heated dies. With this beginning a commercial process was developed and drawn tungsten filament lamps were put on the market in 1911.

Drawn tungsten wire greatly simplified the manufacture of the lamp and at once converted the formerly fragile lamp into a sturdy one.

—National Electric Light Association Bulletin.

Dominion's Position in Power Development

Stands Second on List in Output of Electric Energy per Capita

STATISTICS and comments thereon recently published in the United States, and which include Canada, give a very interesting review of the use of electricity per capita and of the comparative amounts of water power and of fuel power in use in a number of countries.

It is always of interest to see ourselves as others see us and some of the principal results are quoted below, exactly as published with the exception that the Canadian figures are slightly modified to correspond with the final figures with the last Census of Population and the final figures of the last Census of Central Stations.

	Canada	United States
Total electric output in kilowatt-hours per head of population	683	472
Dwellers in electric lighted abodes in per cent. of total population	37.1	36.8
Water power developed, in horse-power per 1000 of population	338	90
Hydro-electric *v.* fuel plants:—		
Water power, per cent. of total	88.1	23.7
Fuel power, per cent. of total	11.9	76.3

It will be seen from the above that the output of electric stations per capita in Canada is nearly one and a half times as great as in the United States and that the amount of water power developed per capita is nearly four times as great—also that water power constitutes 88 per cent. of the electric generating capacity in Canada but only 24 per cent. in the United States.

Of the actual output in kilowatt hours (as distinguished from plant capacity) of central station plants in Canada, 97.2 per cent. is produced by water power.

The output of electric energy in kilowatt hours per capita for the countries leading in this respect stands as follows: Switzerland, 700; Canada. 683; Norway, 493; United States, 472; Sweden, 364.

—Natural Resources, Canada.

Mr. O. M. Perry Honored by Employees of Windsor Hydro System

On the evening of November 10th., the ballroom of the Prince Edward Hotel, Windsor, was the scene of a very delightful event, when the Com-

mission and the employees of the local Hydro system and their friends assembled for the purpose of tendering a banquet to Manager O. M. Perry to mark the tenth anniversary of his being its chief executive officer. Mayor H. W. Wilson was Chairman of the gathering and in addition to musical numbers there were addresses by Hydro Commissioner J. H. Sheppard and Chairman J. E. Banwell. Mayor Wilson, on behalf of the employees, presented Mr. Perry with a travelling bag and Mrs. Perry with a bouquet of roses.

O. M. Perry

After thanking those present for their very kind remembrances, Mr. Perry described the conditions under which the Windsor system began operations when he came there ten years ago, and the vast increase since that time. He felt that the growth reflected the wonderful co-operation and interest of his staff, and the loyalty they showed. The system was being operated in the interests of the public at large and the absolute absence of political influence had contributed considerably to its success.

Hydro Lamps vs. Old Sol

THE key-word of industry and commerce at the present time seems to be "production". On every hand the effort is being made to increase results. Artificial light has been found to have a very decided effect upon production in indusry and upon sales in commerce.

The following suggests its possibilities in a comparatively new and interesting field.

Attention is being directed toward artificial light to accelerate the growth of plants indoors. Inspired by the suggestion a simple experiment was tried in the Illumination Section of the Commission's Laboratories.

Two slips of scented geranium were selected, as nearly identical in size as possible, from the same parent plant and were planted in the same kind of soil in similar pots. One slip was kept on the floor of the lamp life test room and the other in a south window of one of the photometer rooms. In this window plant has an unobstructed exposure to direct sunlight during practically the whole period of daylight.

In the life test room the plant is exposed to full intensity of illumination about 22 hours per day on the average.

The only attention paid to the plants was to keep them watered. The plant in the life test room required water every day while the other required it about once every second day.

Owing to the dry nature of the heat in the life test room the humidity is undoubtedly lower than in the photometer room near the window.

The temperature in the life test room was from 80° to 84°F, and at the window of the photometer room from about 72° on a cloudy day to 79°F. during sunshine.

The intensity of illumination in the life test room where the plant is kept is 4,200 foot-candles.

The photo No. L.1288 shows the difference in growth for 1 month.

Accidents and Shadows; Their Cause and Remedy

By W. E. Bush, B. T. H. Lighting Service Department

THE fact that of recent years the number of industrial accidents has increased appreciably is rather surprising when one considers the number of safety devices which have been applied from time to time for the sole purpose of making apparatus and machinery "foolproof". It is evident that one must look beyond immediate causes for an explanation of this unfortunate paradox. The provision of emergency switches, guards, and other safety appliances, undoubtedly tends to relieve

the number and severity of accidents; but it does nothing to correct the first cause of nearly all accidents, i.e., bad lighting. Workmen do not stumble or put their hands or feet into moving machinery for fun, but usually because they cannot see what they are doing. When serious, and perhaps fatal, consequences ensue the immediate cause, such as unprotected machinery, etc. is blamed; whereas the chief offender is the lighting installation.

Take the case of an operator of a milling machine in a factory at night; the shop floor, especially in the vicinity of the machine, is usually littered with work, thus making it difficult at times to pass from one portion of the shop to another. The operator, in passing round the back of the machine, attempts to step over a heap of work; in doing so he stumbles and, in an effort to save himself, thrusts his hand out and it is trapped in the gears of the machine. The emergency switch is pressed and the motor stops. The switch has justified its existence by operating effectively when required, but it could not prevent the accident, although it certainly limited the consequences. The accident is directly and immediately due to the operator stumbling over a heap of work and, if the man is requested to give his own opinion, he will probably say that he thought he had cleared the heap. The first and real cause of the accident, however, lies in the difficulty of determining the exact position or contour of an object inadequately illuminated by poor artificial light. It is possible that a portion of the heap of work may have been in a dense shadow and could not be clearly seen, or it may be that the light was not properly diffused.

A certain amount of shadow is necessary if objects are to be clearly seen. A turner cutting a thread on a piece of steel in a lathe, can only see the thread because of the shadow which is cast by the thread itself. If the illumination were perfectly even on every portion of the thread, it would appear like a flat surface.

Deep black shadows are very troublesome, and are a source of constant danger because of what they may conceal. They are a definite cause of accidents, although in the majority of industrial works the systems of electric lighting which produce these shadows are not suspected. This is because electric light is generally accepted to be better than any other light and, therefore, is not considered capable of producing effects likely to be harmful to operators of machines, etc.

Until quite recently industrial lighting problems did not receive the serious consideration they deserve. The general principle appeared to be to install a number of lamps in certain positions without due consideration of the requirements of operators, or the efficiency of the light obtained. Consequently, after an installation had been completed a short time, it was very often observed that workmen had moved the lamps and had tied them in the desired positions with pieces of string. Where lights are juggled with in this manner the result must be general inefficiency.

For satisfactory general illumination in industrial plant the lighting should be such that no shadows are produced that are so dense as to make vision difficult where the direct light

from one or two sources is cut off. Again, the shadows should not be so sharply defined as to cause confusion between a machine part and its shadow; they should be soft and luminous and not a source of danger to limb and life.

Electrical Review.

Accident at Penetanguishene

An accident occurred at Penetanguishene on Saturday, September 1st., which deserves special mention due to the fact that Thomas Hartley, lineman in the employ of the local Commission was responsible for saving the life of a man who had been severely shocked while engaged in the operation of an electric motor driven concrete mixer.

This concrete mixer was originally installed in the basement of a building, with all metal parts properly grounded, the electrical work having been performed by a local wireman. The concrete mixer was at a later date moved into the yard and properly grounded to a rod driven into the ground. The conduit carrying the conductors to the mixer and the switch box was also properly grounded. The operators of the cement mixer had evidently moved the machine at various times and in doing so, the conduit carrying the conductors had become detached from the switch box, thus leaving a certain section of the wire without any protection whatever and allowing the conductor to come in contact with the metal frame of the switch box, thus causing a ground at that point. The connection to the ground rod had evidently become detached after the mixer had been moved from its original position in the yard and proper precaution for reconnecting same had not been taken. A piece of galvanized iron had been placed over the switch box on the mixer to protect the former from the weather, and one of the operators, in raising this shield to reach the switch handle to shut off the motor, evidently received a shock which threw him forward on to the machine, in which position he remained for several minutes before being removed. It might also be stated that the ground around the concrete mixer was wet and muddy. and, therefore, the man's body offered a perfect path to ground as soon as contact had been made with the galvanized iron shield over the switch box. The man's assistant, seeing his predicament, rushed to his aid and as soon as his hands came in contact with the body of his companion he also was rendered unconscious by shock.

Thomas Hartley, and another lineman in the employ of the local Commission, happened to be working near by and immediately came to the aid of the two injured men, each putting into practice their training in resuscitation which had been given them at various times to enable them to take care of emergencies of this kind. Thomas Hartley, being more skilled in the art of resuscitation, succeeded in reviving his man after working on him for thirty-five (35) minutes, but the other lineman was not so successful and was unable to revive the other man he had been working on. In justice to Thomas Hartley, it might be stated that he continued to work on his man after the Doctor had given him up as dead and this man is now going about his work without any evil effects of the accident.

The Toonerville Trolley Which Meets all the Trains

The picture shown herewith is not the original of the above title, but is that of an improvised car that operates between Nipigon Camp and the Canadian National lines. It was originally a flat car, but was later boxed, and is drawn to and from the Canadian National lines by a donky engine. It is used for carrying passengers, baggage and freight. The crew consists of a conductor, brakeman, baggage man, fireman, express messenger and mail clerk, all in the person of the engine driver. The decorations were added one night by some of the boys of the camp.

Walt Whitman's Boosting Poem

Don't sit supinely on your roost,
But come along and help us boost
For better things of every kind
And leave your kicking clothes behind.
Oh, let us boost for smoother lawns,
For better lights and shorter winded
 bletherskites,
For finer homes, for taller trees,
For bats and boots and bumblebees,
For shorter hours and longer pay,
And fewer thistles in our hay,
For better grub and bigger pies,
And two more moons to light the sky,
And let the wolves of war be loosed
On every man who does not boost.

—Wiarton Canadian Echo.

"He is Thinking About Packards"

Not long ago a man, who ranks as a department head in a factory not far from here, was walking through one of the departments, swinging along in a rather supercilious manner, rather than nodding to others as he passed them.

Some one asked the man through whose department he was passing, "What is the matter with Jones? He seems quite airy this morning."

"Oh, that's nothing," replied the foreman. "He is thinking about Packards!"

Doesn't that expression fit in pretty well with quite a lot of people we run across from time to time—men and women, who, instead of thinking about their jobs, instead of devoting all their eight or ten hours a day to the work for which they are paid, spend a good deal of the energy in "thinking about Packards?"

Hoping to own a fine car is absolutely the proper ambition. I am

talking about an entirely different kind of dreaming.

Girls are thinking about the time when some gay Lothario will snatch them away from the arduous and distressing task, to which, perforce, they are chained; and young fellows are thinking of the jazz music to which they will listen that evening or dream about the hour when they will be released from the curse of their employment.

Others are waiting for their ships to come in, in the form of the passing of a relative of theirs, or of their wife's.

"Thinking of Packards" is the occupation of a type of individual of which there are altogether too many. These dreamers do not, as a rule, get very far.

They generally think themselves of much more consequence than they are, and are the type which, if some "ancestor" should leave them the gift-price of a Packard, would assume somewhat large head proportions.

If the maiden who "thinks of Packards" instead of thinking of her job should be snatched from her fiery furnace of labor she would be apt to strut quite consequentially, basking in the light of her rescuer rather than in the light of her own ability and personality.

Such a one might be like the wife of a certain lawyer, who, after hard work for many years was appointed judge of a federal court, much to his wife's satisfaction.

She loved to hear him called "Judge" and asked him, one day, "Now that you are a Judge what am I?" To which the long-suffering man replied: "You are the same darn fool you always were."

As a rule the really worth-while people do not strut, and although they may have plenty of Packards, do not dream of them. It is the little person who struts and thinks of himself or herself more highly than should be.

It isn't a half-bad idea for us creatures of earth who are employed by some one else as department heads, salesmen, sales managers, or even officers of companies, to think at least during the working hours, of the task at hand and "think of the Packard" in quiet seclusion and tell no one.

Strutting gains nothing but sneers, and interferes materially with successful accomplishment.--

—Turnbull Cheer.

HYDRO NEWS ITEMS

Central Ontario System

Estimates are being prepared for improved street lighting on Dundas St. in Napanee.

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Work has been started on a two and one-half mile extension to the rural system in Kingston township.

* * *

Contracts have been signed and construction will be carried out next season on lines to serve the village of Grafton and the surrounding rural district.

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Lines are under construction in the Bowmanville Rural Power District.

* * *

A line to serve one customer on the Kingston Road is being constructed in the Trenton Rural Power District.

* * *

Niagara System

A large artificial ice plant is about to be built at Windsor which will require 1000 h.p. from the local System. The ice is to be used for refrigerator cars.

* * *

The present 26,400 volt line to Sarnia is fully loaded and a 110 k.v. line from London is being considered. With a 110 k.v. Station at Sarnia, the present 26,000 volt line would form a very substantial tie line between two main Stations.

Work has been commenced in connection with 4000 volt transmission lines to the Villages of Jarvis and Wheatley.

* * *

Ottawa System

A new contract for 25 h.p. has been secured in the Nepean Rural District. A three phase line of about half a mile will be necessary to serve this consumer.

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Rideau System

The local Hydro Commission in Smiths Falls are arranging to invest their surplus funds in bonds of the Province of Ontario.

* * *

In the recent action of the Kemptville Milling Company versus the Village of Kemptville, the municipality was awarded judgment with costs and damages on a counter claim. The proposed appeal by the company has now been abandoned and they have signed an agreement with the Village, by which they agree to resign their claims, remove their poles from the streets, and pay all preliminary costs of appeal.

The Village on their part, agree to pay their own costs in the action and waive their counter-claim. The Village costs in this action will be paid from the surplus funds of the Local Hydro Commission.

St. Lawrence System

The Municipality of Alexandria have engaged a man to construct an extension of the system to the Hamlet of Green Valley. The extension will be 3 phase standard rural construction and will supply a wood working plant requiring a maximum of 60 h.p., as well as several lighting consumers.

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An additional power consumer is to receive service in Winchester Village, requiring 20 h.p. to operate a chopping mill.

* * *

In the presence of members of the Public Utilities Commission and other interested citizens, the two gasoline pumping units installed at the waterworks station at Brockville for the Commission were this morning (December 5.) given a thorough and satisfactory test before being accepted from the manufacturers.

Each of the pumps, manufactured by Babcock-Wilcox and Goldie McCulloch Co., Limited, Galt, and operated by Sterling engines has a capacity of 2,000,000 imperial gallons per day at 110 lbs. pressure, equal to six and two-thirds fire streams from a nozzle one and one-eighth inches in diameter.

The engines are rated at 225 horsepower at 1,500 revolutions per minute, but were, however, tested at but 1,375 revolutions per minute.

With six fire streams in operation, the pumps maintained a pressure of 110 lbs. and when the pumping plant had been entirely shut down, the new units were found to attain a pressure of 110 lbs. within three minutes.

Dr. H. A. Clark, chairman of the Public Utilities Commission, estimates that because of a saving in the amount of coal consumed, and a reduction in other expenses, the new pumps will pay for themselves within four years. The estimated saving in fuel through their installation is $4,000 per annum and the cost of the pumps will be between $12000 and $13,000.

The pumps have been installed for the purpose of providing the most adequate fire protection possible. In the event of a failure of Hydro power, it is stated that under the old system of a steam emergency unit, at least half an hour would be required to develop fire pressure. Within this space of time it would be possible for heavy fire loss to occur. The new pumps are to provide for such an eventuality and fire pressure may be attained within three or four minutes instead of within half an hour.

—Brockville Recorder & Times.

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A. M. E. U.
Names on Election Ballot

The Election Ballots which will be distributed and marked on the first day of the January Convention (January 24, 1924), will contain the following names as candidates for the various offices :—

PRESIDENT,
J. E. B. Phelps, (acclamation).

VICE-PRESIDENT,
J. J. Heeg.
V. S. McIntyre.

SECRETARY,
S. R. A. Clement, (acclamation).

TREASURER,
A. E. Clark.
G. J. Mickler.
DIRECTORS AT LARGE,
W. R. Catton,
M. J. McHenry,
O. M. Perry,
O. H. Scott,
R. H. Starr,
P. B. Yates.
DISTRICT DIRECTORS,
Niagara District,
J. G. Archibald,
E. S. Frost.
Central District,
H. O. Fisk,
J. E. Skidmore.
Georgian Bay District,
J. R. McLinden.
E. J. Stapleton.
Northern District
R. H. Staford, (acclamation).
Eastern District,
(To be named at Convention).

List of Electrical Material, Devices and Fittings

Approved by The Hydro-Electric Power Commission of Ontario in November 1923.

Appliances

HACK FUEL OIL BURNER SYSTEM, (Submittor), 1301 Lansdowne Ave., Toronto, Ont.

CORMAN ENGINEERING CO. LIMITED (Mfr.), 347 Dufferin St., Toronto.

Motor-Operated Oil Furnace.

* * *

THE FRANK E. WOLCOTT MANUFACTURING COMPANY, Hartford, Conn.

Curling Iron, "Wavette".

* * *

DURABLE ELECTRIC APPLIANCE CO., 81 Jarvis St., Toronto, Ont.

Portable Air Heaters, Cat. Nos. A. 101 and B. 102.

* * *

J. J. MCLAUGHLIN LIMITED, 145-155 Sherbourne St., Toronto, Ont.

Electrically-operated Carbonators.

* * *

HAMILTON ENGINEERING SERVICE LIMITED, 195 King William St., Hamilton, Ont.

Blue Print Dryer.

UNITED DRUG CO. LIMITED, (Submittor), 78 Broadview Ave., Toronto, Ont.

THE FRANK E. WOLCOTT MANUFACTURING COMPANY, (Mfr.), Hartford, Conn.

Curling Iron, "Electrex".

* * *

*PHELPS ELECTRIC CO., 227 W. Randolph St., Chicago, Ill.

Sign Flashers, "New York Flashers", Types G, 4-G, L.V. "Skedoodle", Cat. No. 162.

* * *

*LANDERS, FRARY AND CLARK, New Britain, Conn.

Suction Cleaner, "Universal", Cat. No. E720.

* * *

*DELCO-LIGHT COMPANY, Dayton, O.

Refrigerating Machine "Frigidaire".

* * *

*GENERAL ELECTRIC CO., Schenectady, N.Y.

Industrial and Laboratory Heating Appliances.
G. E. Glue Pots, Types I-1, I-2, I-4, I-6, I-15 to I-18 incl.
Soldering Irons, Types I-8 to I-12 incl.
Melting Pots, Cat. Nos. 1914582, 246128.
Soldering Iron Heaters, Cat. Nos. 223401 223402.
Tool Hardening Furnaces, Cat. Nos. 223812, 223816, 246408.
Rivet Heaters, Cat. Nos. 1950816G-1 to 1950816G-10 incl.
Melting Furnace, Type SM.
Tempering Oven
Box Type Furnace, Cat. No. 246409.

* * *

Fittings

A. L. Wynston, Jr., 77 York St., Toronto, Ont.

Porcelain Bushings for Knockouts "V or W".

* * *

*All-Steel-Equip Co., Aurora, Ill.
Outlet Plates.

* * *

*All-Steel-Equip Co., Aurora, Ill.
Fittings for Conduit Boxes—Covers.

* * *

Miscellaneous

*Phillips Electrical Works, Ltd., Eugene F., de Gaspe and Marmier Sts., Montreal, Que.
Wires-Slow-Burning
Slow-Burning Fixture Wires.

* * *

*These devices are under the Underwriters' Laboratories re-examination or label service.

Index to Volume X.

Laboratory Facilities Behind the Hydro Lamp

Our Inspector at Work

All Hydro Lamps are Factory Inspected and Tested by a Hydro Inspector